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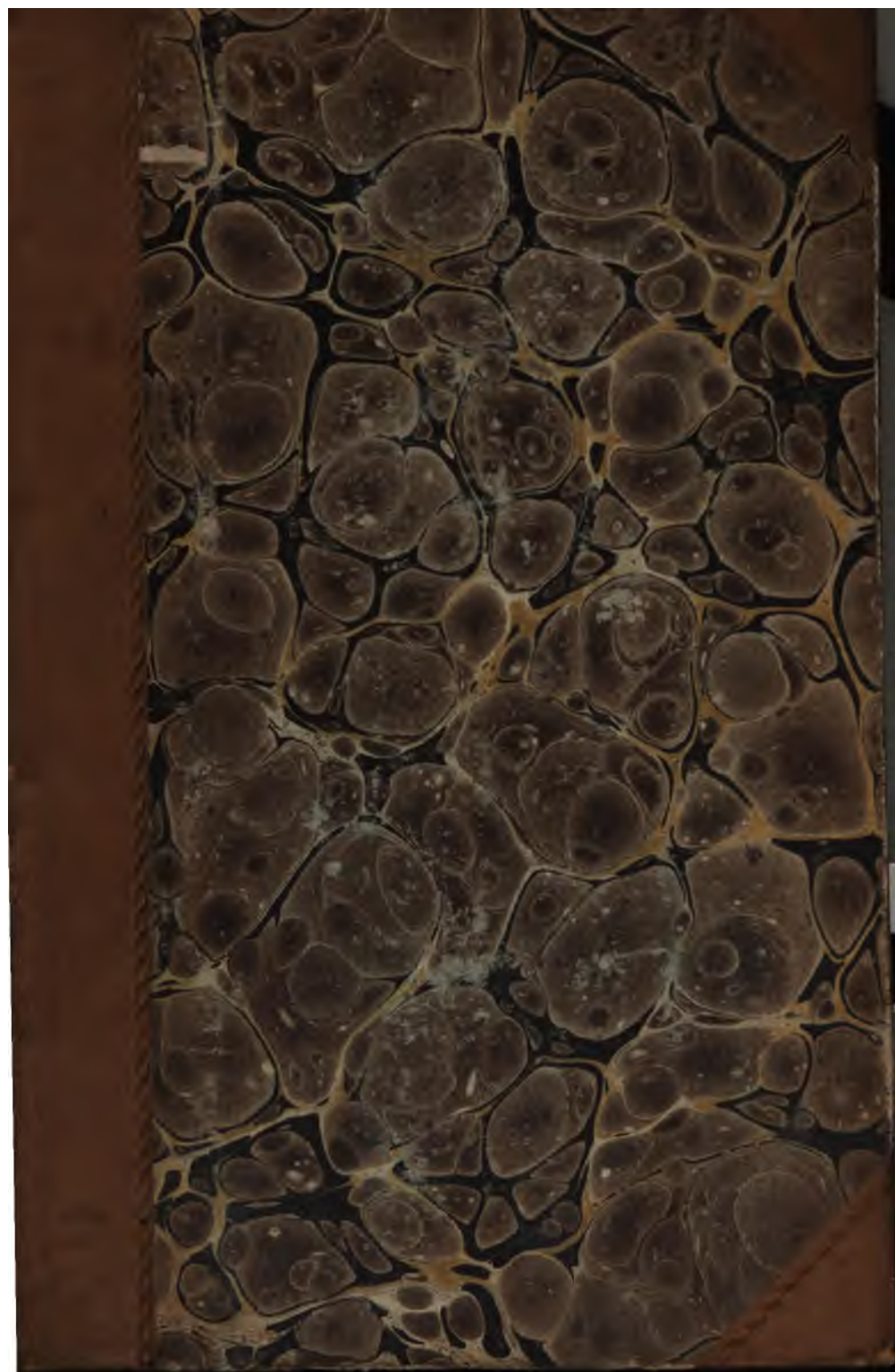
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D E A F N E S S ;

ITS CAUSES,

PREVENTION, AND CURE.

BY

JOHN STEVENSON, Esq.

MEMBER OF THE ROYAL COLLEGE OF SURGEONS,

LECTURER ON THE STRUCTURE, ECONOMY, AND DISEASES OF THE EYE AND EAR,

AND SURGEON-OCULIST AND AURIST EXTRAORDINARY TO

HIS ROYAL HIGHNESS THE DUKE OF CLARENCE.

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TO HIS ROYAL HIGHNESS
THE DUKE OF CLARENCE, K. G.
LORD HIGH ADMIRAL OF ENGLAND,
&c. &c. &c.

SIR,

MY former treatises on two very important diseases of the Eye, namely, "On Cataract," and "On Weakness of Sight," in which new views and successful modes of treatment were unfolded, having been successively presented to the public, with the Most Gracious permission, and under the patronage of His Majesty, and His Royal Highness the late Duke of York, to whom can I so appropriately, as to Your Royal Highness, dedicate *this my first publication* on the interesting class of Aural Affections?

The gracious permission to prefix the name of Your Royal Highness to the following pages, is no less flattering to my ambition, than gratifying to my feelings. I gladly avail myself of the opportunity which that permission affords me, of offering my most humble and grateful acknowledgments for the additional and still more distinguished favour Your Royal Highness has been pleased to confer on me, and in a manner which gives double value to the honour,—the appointment of Surgeon-Oculist and Aurist Extraordinary to Your Royal Highness.

I have the honour to subscribe myself, with the highest sense of duty and respect,

Sir,

Your Royal Highness's

Most obliged, faithful,

And humble Servant,

JOHN STEVENSON.

*Margaret Street,
Cavendish Square,
June 2, 1838.*

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ON DEAFNESS,

&c. &c.

CHAPTER I.

INTRODUCTORY.

OF the organs appropriated to the several senses by which man is connected with the material world around him, no one affords a more interesting subject for contemplation and investigation than the Ear. It is, in its perfect state, one of the principal instruments of our social intercourse, and conveys to us some of our most sublime and delightful sensations,—those of harmony and melody. Sup-

posing, for a moment, that man had been created without this important sense, a principal entrance of human knowledge would have been entirely closed to him, and, consequently, his means of receiving instruction would have been greatly curtailed. Whilst the eye, from its position in the upper and forepart of the head, embraces only a limited sphere for the exercise of its function, and, moreover, requires the presence of light to enable it to display its powers, the ear is always open, and like a watchful guardian, by day and night, conveys to us information of what is moving around us; and when our sight would avail us nothing, forewarns us, by certain signs, of impending danger.

Since, therefore, we derive advantages so considerable from this organ, in its sound state, surely it is deserving of all that the most enlightened surgical science and skill can effect for its relief, when diseased.

A brief detail of the various and complicated parts of the ear is sufficient forcibly to excite our admiration, when we reflect on the beautiful adaptation of its mechanism to the office intended to be performed by it in the animal economy. Possessed of the full exercise and enjoyment of this sense, we are scarcely aware of the privations endured by those in whom it is entirely annihilated, or even partially blunted; and until we ourselves become sufferers, we do not properly or feelingly appreciate its inestimable value.

Those whose organ of hearing has from birth never been susceptible of the impressions of sound, are incapable of calling into action another of the munificent gifts of the Creator,—language; for, although the apparatus of the voice be in all respects perfectly formed, yet, as speech is an art acquired by imitating sounds that are heard, and such persons not having the faculty of

hearing sounds, they are obviously incapable of learning to utter them; being born *deaf*, they are by necessity *dumb*.

In some cases, even of this extreme and deplorable description—as I have repeatedly had the satisfaction to prove—surgery affords substantial, indeed perfect relief; and, as M. Leschevin elegantly observes, “the surgeon, by a double miracle, gives hearing and speech to an animated being, who, deprived of these two faculties, can scarcely be regarded in society as one of the human race. How highly must such operations raise the utility and excellence of surgery in the estimation of the world!”*

We all remark and commiserate the condition of our relatives or friends, who, having once enjoyed the full advantages of hearing, are now become partially or entirely deaf;

* M. Leschevin's Dissert. in Memoires sur les sujets proposés pour le prix de l'Acad. Royale de Chirurg. tom. 9. p. 111, 112. edit. 12mo.

in fact, to be deprived of the pleasure and instruction of conversation appears to persons thus afflicted so great a calamity, that they would willingly exchange the use of their eyes for the restoration of the function of the ear. Accordingly, deaf persons are always observed to be more depressed, unhappy, and discontented in company than the blind. This is owing to their feeling themselves more isolated beings, thus excluded from participation in that social converse which gives birth to the liveliest moments in the darkened hours of those who are deprived of their visual faculties.

My object in the following pages is, to give a clear and concise view of the history and treatment of DEAFNESS, and the *various diseases of the ear*, — which I flatter myself will be found no less adapted to the general than to the professional reader. And in order to make the work more readily understood by the former, I shall prefix a

succinct account of the anatomy of the ear—or, in other words, a description of its complex mechanism, together with the physiology, or function and uses, of the parts separately and conjointly—so far as they have been hitherto satisfactorily explained.

That the general reader may not be interrupted in his perusal of the text, I have embodied and reduced into the form of notes such philological and scientific explanations and disquisitions as might not be so easily understood by any but medical scholars; and with a further view to render the subject less dry and more interesting, literary and illustrative remarks and facts have been freely interspersed throughout the whole; while technicalities are as much as possible avoided, or inclosed between brackets in the text.

CHAPTER II.

ON THE ANATOMICAL STRUCTURE OF
THE EAR.

It is scarcely necessary to premise that the ear, (derived from the Latin *auris*, and the Greek *οὖς*,) is that organ by the agency of which we are rendered sensible to the impression of sound. For the exercise of this important function, it is in an eminent degree adapted, as well by its situation and external artificial structure, as by its internal and exquisitely curious mechanism.

But, as it is impossible clearly to comprehend the nature of the various and complicated diseases of the ear, and success-

fully to treat them, unless we possess a knowledge of the situation, organization, and function of the parts affected, it will be requisite to prefix a concise and general anatomical and physiological description of the auditory apparatus.

The ear is an organ specifically and exclusively appropriated to the sensation of sound, for we are not conscious of any other office in the animal economy it is capable of fulfilling;—whereas, the *skin*, besides conveying the sensation of *touch*, serves likewise as a covering to our bodies, as well as an outlet for perspiration. The *tongue*, whilst it conduces to the sense of *taste*, assists also in speech and in the act of swallowing; and the *nose* is auxiliary to the function of respiration, as well as the seat of *smelling*.

Again: the matter or substance which is the primary and sole cause of sonorous vibrations, comes not in contact with the

immediate seat of the sense; whereas the agents which excite respectively the sensations of touch, taste, and smell, are applied *directly* to the part which is formed to receive the impression.

The mechanism by which vibrations are received and carried inward to the expanded sentient extremities of the auditory nerve, varies in structure according to the peculiar nature of the medium in which it is intended to be exercised.

Thus, for example,—the complex and perfect structure of the human ear is designed to perform its function in *air*, which has the least power of any substance or modification of matter to transmit sonorous modulations; whilst that of fishes is adapted to the *aqueous* medium, which, being a much better conductor of sound than the atmospheric fluid, requires an apparatus far less delicately constructed.

But whatever the number, complexity,

or form of those parts which may be considered subsidiary, there exists, in every creature enjoying the sense of hearing, a structure analogous and equivalent to the labyrinth, in which the nerve subservient to the sensation of sound is distributed.

As an additional assistance to terrestrial animals, whose organ of hearing is designed to be exerted in the circumambient air, they are furnished by nature with an outwork called the *external* ear,—the only visible part of the apparatus by which the undulations of sound are collected and increased in force.

The faculty of hearing is confined to certain classes of animals, the more imperfect not appearing to be endowed with this sense. Insects, however, certainly possess it, if what is related of bees, in reference to the effects of tinkling and loud noises upon them, be entitled to credit; although the auditory apparatus is not discover-

able by the nicest dissection in any order of created beings below the finny tribes, in which it is equally simple and distinct.

The ears are double,—an arrangement which affords a provision against the loss or injury of one of them ; at the same time that, by their commodious position on each side of the head, they are enabled the better to perceive noises in every direction. “ As the eyes are placed at the upper part of the body, like two watchmen, to descry approaching danger, so are the ears seated there also, that they might give information of what the eyes cannot discover, either in the night for want of light, or through the interposition of some thick and opaque body which the sight cannot penetrate ; and as the eyes contemplate the wonderful works of God, whereby the mind may conceive his infinity, so the ears are the inlets or receivers of verbal instruction in all wis-

dom and science ; for they are the organs of hearing." *

Like all organs designed to receive the impressions of surrounding agents, the ears are symmetrical—exactly resembling each other in structure. The description of one may, therefore, with the greatest facility and correctness be applied to the other.

Of all the organs in the human body, the ear is unquestionably the most complicated and the most elaborately formed. The ears of fishes, reptiles, birds, and quadrupeds, exhibit a regular gradation ; but in the human ear we find united all the different apparatus for transmitting vibrations to the internal organ, together with the most extensive communication of nerves in the labyrinth or inmost division of the ear, to receive that delicate impression. The final cause of this more complicated struc-

* Gibson's Anatomy, page 416.

ture in man is doubtless the greater power wherewith he is endowed of perceiving, through the ear, various impressions of simple sounds, language, music, &c. of which diversified modifications of the sense the lower animals are probably not susceptible.

It may, it is true, be argued that birds are the most musical of the whole creation; and indeed they have a most exquisite hearing, though possessing only the rudiments of that part of the labyrinth called the cochlea. But then, it should be recollected that their head is like a bell, almost entirely sonorous, owing to its not being involved in thick bones and muscles, like the heads of other animals. Hence their susceptibility to be agitated by the gentlest impulse of sound,—and their labyrinth, being very sonorous, is fully sufficient for that purpose. The most simple grotto will echo back a musical sound.

If to this excellent disposition in birds nature had added a cochlea, they would in all probability have been still more alive to harmonious modulations, and in that case have had a passion for harmony, as almost all animals have for the indulgence of their sensual appetites. The musical quality peculiar to birds proceeds, perhaps, less from the delicacy and taste of their ear, than from the disposition of their throat. In this respect they may be supposed to resemble certain musicians, who give pleasure to others of which they themselves participate in a very slight degree.

But it is time to point out the divisions, and to describe the structure of the human ear.

To give a clear description of the relative position and structure of the constituent parts of this organ, is a task of no small difficulty, on account of the delicacy, minuteness, and complexity of many of

them,—and especially of the internal machinery.

With a view to render the subject more easily intelligible, anatomists have been in the habit of dividing the organ into the external and internal ear. Valsalva, however, who published a valuable work on the anatomy of this organ, distributes it into *three* portions, namely, the *external*, the *middle*, and the *internal*; an analysis so perfectly easy and natural, (inasmuch as it results from the distinct function severally performed by the different parts,) that we shall adopt it in preference to the more common division of the subject.

These three portions are evidently constructed for peculiar and different purposes; all contributing, however, and more or less necessary, to fulfil the complete series of function.

According to this arrangement, the first or external part consists of the auricle and

the auditory canal (meatus auditorius externus), commencing at the outer opening of the ear, (concha,) and terminating at the membranous partition of the drum, (membrana tympani.)

The middle cavity, denominated the drum, (tympanum,) is situated between, and is equally connected with, the external and internal parts. It contains a beautiful assemblage of small bones, (ossicula auditus,) evidently intended to modify and carry forward those pulses of air to the auditory nerve which have been collected and transmitted to the membrana tympani by the auricle and auditory tube.

The third or internal part of the ear is the immediate seat of the sense. It consists of several cavities situated in the petrous portion of the temporal bone, and contains a membranous texture upon which the sentient extremities of (the portio mollis of the seventh pair) cerebral nerves are

expanded. From the intricacy and meanderings of these canals, they have received collectively the appellation of the labyrinth.

Having thus briefly pointed out the artificial division of the ear, we are now prepared to enter upon the anatomical consideration and description of its constituent parts.

SECT. I.—*Of the Auricle, or external ear.*

Pursuing the order of our classification, that which first solicits our attention is the auricle; the position, form, and structure of which are admirably adapted for the purposes of its economy. It is more full and rounded in men than in females; and even in persons of the same sex, the auricle does not possess an equal degree of magnitude. Its figure, too, is not unfrequently very different, the eminences and depressions being more strongly marked in some

than in others. The Europeans have generally a smaller ear (which the Romans regarded as an indication of beauty) than the inhabitants of other climates, amongst some of whom it is found to attain a prodigious size.

The term auricle* is often used to express the whole, as well as a part only, of the organ. It is composed principally of a firm elastic cartilage, elaborately and exquisitely formed, and to which it owes its figure. It is similar in structure to the

* Spigelius seems to have been the first anatomist who called the outer ear by the name of auricula, to distinguish it from the inner, termed auris. The auricle, by its elegantly formed oval figure, its eminences, depressions, sinuosities, and general contour, presents Hogarth's line of beauty, and a good artist takes care never to conceal it when well-formed. In the idols of ancient Egypt, the auricle seems uniformly to be situated higher up on the side of the head than in modern pictures; representations which, judging from the fidelity and finished workmanship in the rest of their construction, cannot be regarded as false, or the effect of ignorance.



lower soft part of the nose, (*alæ nasi*,) and is invested, like the bones, with a highly vascular covering, (*perichondrium*,) to which is connected, by means of a little cellular membrane, a very thin tense skin, giving it a smooth shining appearance. It is also furnished with small glands, first noticed by Valsalva, (*glandulæ, vel folliculæ sebaceæ*,) for the purpose of secreting an oleaginous substance, which serves to lubricate and keep it in a due state of flexibility, whilst it obviates at the same time the effects of friction, and of changes in the weather.

The lower soft part of the auricle is termed the lobe, (*lobulus*,*) as the upper

* The term *lobulus* is derived, according to Fabricius ab Aquapendente, from ἀπὸ τοῦ λαμβάνειν, (to lay hold of,) *quod eam prehendimus partem cū aliquem admonemus*. Hence Virgil,

“Cynthiaus aurem

Vellit et admonuit.”

cartilaginous portion just described is called the pinnacle, (pinna,*) the simple form of which is expressed by its name.

The lobe, which is found only in the human species, is the soft pendulous† por-

* The term pinna, (so called by Vesalius, but before his time *fibra* and *ala*,) is probably derived from the Greek word *πιννα*, (*conchæ* genus,) a shell-fish, which the part is said to resemble. Hence, “*Concharum generis et pinna est*,” says Pliny. Fabricius ab Aquapendente thinks it is named pinna because of its situation at the summit of the auricle, like the tops of walls, which were called *pinnæ* or pinnacles. Without contending for the origin of the term, suffice it to say, that it constitutes the superior and larger portion of the auricle, and is placed immediately behind the articulation of the lower jaw.

† This is the part to which ear-rings or pendants are usually affixed, called *ἐλαβία* by the Greeks, who, regarding them as indications of nobility, had them manufactured of the most costly materials and elegant workmanship; whilst, on the contrary, they were looked upon by the Romans as marks of servitude, and were consequently very coarsely con-

tion of the auricle, and is composed of a simple duplicature of the skin, containing adipose substance, sebaceous glands, blood-vessels, and absorbents. The whole of the auricle is very scantily supplied with nerves, and hence the cause of its possessing less sensibility than any other of the soft parts of the human body. Had this not been the case, the most serious inconveniences must frequently have ensued on account of its situation exposing it to occasional contusions and compression, from which it recoils by its natural elasticity.

The auricle, being highly vascular, but without fat, which would have impaired

structed. To show how far imagination will sometimes mislead men, Casserius, in his valuable work on the ear, erroneously asserts that there is a natural aperture at the top of the lobe, for the express purpose of receiving the ear-rings, which by some Indian nations are made so heavy as to elongate the ear to an almost incredible length.

its elasticity, is a structure so curious as richly to deserve our attention and admiration. While it resembles, as Winslow observes, the inverted shell of a muscle, it is as far from possessing the softness of muscular fibre as the hardness of bone. "Had it," as Gibson judiciously remarks in his *Anatomy*, "been bone, it would have been troublesome, and might by accident have been broken off; if flesh, it would not have remained expanded; but being formed of elastic cartilage, it has the polish and the folds most proper to collect, reflect, and transmit sounds to the bottom of the auditory passage."

It may be further added, with respect to the auricle, that, were not its natural form altered by bandages, as is too much the custom among civilized people, it would project obliquely forward from the head. This is actually the case with the savage African and some eastern nations—a dispo-



sition of the auricle which not only conduces essentially to their greater acuteness of hearing, but likewise, as Cassebohm* observes, contributes to prevent that excoriation behind the ears to which Europeans in early life are very subject.

The auricle varies in its structure in different animals according to the necessities of each species. In man it is of a form proper for his erect position. In quadrupeds, most of which are capable of exercising considerable muscular power over this part or appendage, its figure is conformable to the position and slow motion of their bodies. In them it also varies according to their various occasions:—in some it is large, erect, and open, in order that they may be more sensible of the approach of danger. In the subterraneous animals, whose necessities and mode of existence oblige them to dig for their food and habitation—as for instance the mole,

* *Tracti di Aure humanâ*, Halle, 1730, 4to.

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* *Tracti di Aure humanâ*, Halle, 1730, 4to.

the organ is excavated, and long and large enough to afford harbour to insects ;—whilst in birds, whose ears are covered with feathers, and in which the drum lies superficially or a little way only in the skull, this substance does not exist, none being wanted to ears so well guarded, and with so short an auditory tube.

The extremity of the auditory canal is closed by a fine semi-transparent membranous septum, called the skin or membrane of the drum,* (*membrana tympani*,†) the outer part of which it covers ; and this exhibits, when viewed in a strong light, a vascular as well as a somewhat tendinous appearance, especially in persons advanced in life. It is implanted in the orbicular

* A name derived from the fancied resemblance it bears to the box of that instrument.

† By the older anatomists this membranous partition, the *membrana tympani*, is called *myrinx*, *myringa*, and sometimes *hymen*.

groove of the bony ring (annulus osseus,) of the temporal bone, the prolongation of which forms the osseous portion of the auditory canal. Its position is neither vertical nor horizontal, but oblique, making, as already remarked, (page 27,) the lower part of the auditory canal longer than the upper. And as was shown in p. 28, it is strengthened externally by the common integuments, and internally* by a reflection of

* A great variety of opinions have been offered as to the structure of this membrane; Casserius deriving it entirely from the pericranium, and Laurentinus from the external covering of the brain, whilst Valsalva maintains that it is a double membrane, the internal lamina proceeding from the dura mater, the external from the skin of the meatus. Ruysch adds a middle vascular membrane, and Winslow declares that it consists of four laminæ. This membrane, called by the old writers the tympanum, is noticed both by Aristotle and Hippocrates, the latter of whom, in his book *De Carnibus*, says, “*Pellicula in aurem juxta os durum tenuis est veluti arenarum tela, et omnium pelli-*

cartilaginous portion just described is called the pinnacle, (pinna,*) the simple form of which is expressed by its name.

The lobe, which is found only in the human species, is the soft pendulous† por-

* The term pinna, (so called by Vesalius, but before his time *fibra* and *ala*,) is probably derived from the Greek word *πύρα*, (*conchæ* genus,) a shell-fish, which the part is said to resemble. Hence, “*Concharum generis et pinna est*,” says Pliny. Fabricius ab Aquapendente thinks it is named pinna because of its situation at the summit of the auricle, like the tops of walls, which were called *pinnae* or pinnacles. Without contending for the origin of the term, suffice it to say, that it constitutes the superior and larger portion of the auricle, and is placed immediately behind the articulation of the lower jaw.

† This is the part to which ear-rings or pendants are usually affixed, called *ἐλαβία* by the Greeks, who, regarding them as indications of nobility, had them manufactured of the most costly materials and elegant workmanship; whilst, on the contrary, they were looked upon by the Romans as marks of servility, and were consequently very coarsely con-

tympani of the human subject a radiated muscle, the fibrous appearance of which is perhaps owing to the peculiar distribution of its blood-vessels. If, however, the conjecture of that anatomist be correct, it must of necessity be an exceedingly delicate muscle, and would seem to bear a miniature resemblance to that muscular partition between the cavity of the chest and abdomen, denominated the diaphragm, which is covered above by the reflection of the pleura, and below by that of the peritonæum.

The membrane of the ear is not a perfect plane, although always in a certain degree of tension, more so indeed in old persons than in young subjects, being convex toward the drum, and a little conical, the apex being the centre to which point the handle of the mallet (malleus) is attached.

In birds, the convexity of this membrane



membrane of the drum, (*membrana tympani*). Subsequent experiments, however, have proved the inaccuracy of his notion on this point. The smoke that can by some persons be made to issue from the ear by compressing the nostrils, closing the mouth, and forcing the inspired air into the upper part of the fauces, proves only that the membrane is not entire and perfect, in consequence of rupture, or of a portion being absorbed by the process of ulceration.

It is rarely possible, in the natural state of the parts, to see the membrane of the tympanum ; but by a little management on the part of the operator, if the passage be not unusually long, narrow, and tortuous, or filled with a redundant growth of hair, it may be rendered conspicuously visible in a strong bright light.

This membrane is exceedingly vascular and sensitive ; and hence the acute pain

consequent upon an insect or instrument coming in contact with it, or when inflamed.

But from the outer tube of the ear, let us next carry our inquiries to the interior part of this admirable organ, where we shall find the most exquisitely skilful provision made for every occasion and emergency.

The internal machinery is contained in the petrous portion of the temporal bone, situated completely out of sight at the very basis of the skull, and so called from its rocky hardness, which not only serves to protect this delicate organ with a case strictly proportioned to its curious texture and extensive usefulness, but is also calculated to maintain and augment by reaction the pulses of sound.

SECT. II.—*Of the Tympanum, or middle cavity of the ear.*

The middle cavity of the ear (tympan-

num*) is situated at the inner side of the membrane of the drum, (*membrana tympani*,) intermediate between it and the internal ear. The drum is in reality a cavity, communicating with the external atmosphere by means of the opening into the throat, (the Eustachian trumpet,) and is filled with air.

Its figure is irregularly round, or rather hemispherical; and its bony superficies is distinguished by numerous little eminences, depressions, and holes, (*foramina*,) rendering it of unequal depth in different parts, the length and breadth being nearly equal, and measuring on an average from half to

* The tympanum, middle cavity, or drum of the ear, is called by Fabricius, Casserius, and several old writers, *concha*,—by others, *tympani cavitas*, *antrum*, and *pelvis*,—and was formerly considered to be the *immediate seat* of hearing, Vesalius having asserted that it is lined by an expansion of the auditory nerve—a statement long ago proved to be erroneous.

three quarters of an inch. As, however, the figure and relative size of the drum are observed to be very various in different species of animals, each of which, nevertheless, possesses a perfect sense of hearing, we cannot determine the relative importance or peculiar advantage of any particular configuration.*

In the drum, there are two open passages; the first that we shall briefly notice, is that of the mastoid cells, (*cellulæ vel cavernulæ mastoideæ*;) which were first described by Veslingius, a celebrated anatomist. They are situated in the mastoid process, (the bony projection behind the auricle,) and open into the upper and back part of the drum by a large irregular orifice,

* Anatomists notice five particular points in the tympanum, namely, two open passages, two that are closed, viz. the fenestra ovalis and rotunda, four ossicles, three muscles, and the branch of a nerve, (*corda tympani*.)

opposite to, but rather higher than the other aperture into the Eustachian tube. They are divided by bony laminæ into large unequal cells, freely communicating with each other, but which are often obliterated in advanced life.

They may be considered as an extension of the cavity of the drum, to assist the vibration of sound, since the communication between them is perfectly free, and since they are lined by a continuation of the same vascular membrane, which, like that of the nose, (*membrana schneideriana* or *pituitaria*;) secretes a fluid for the purpose of lubricating the internal surface, at the same time that it serves as a periosteum or lining.

Cassebohm states that, if this cavity be opened in a person who has died of a *chronic* disease, this periosteal lining will be found very pale-coloured; but in those who have fallen victims to an *acute* malady, it

will appear, according to Vicussens, (an author who wrote an elaborate work on the ear,) of an intense red. In a dried ear, it adheres to the osseous parietes so closely, as with difficulty to be distinguished from the bone, (especially in such as have been exhausted by a tedious illness,) unless tepid water be poured upon and allowed to macerate the membrane, by which process it becomes thickened, and may be separated from the bone.

In most of the four-footed mammalia, which hear acutely, there is a large cavity connected with that of the drum, which seems to supply the place of the mastoid cells. In the pig, and in horned cattle, the cavity is divided into cells by bony plates, somewhat resembling the divisions in a ripe poppy-head.

In several animals this organ forms a mere bony cavity, called *bullæ osseæ*, as in the dog, cat, martin, squirrel, hare,

and some of the bisulcæ or ruminantia of Cuvier.

In the anterior and upper part of the edge of the drum, is placed the aperture leading into the throat, which is commonly called the Eustachian* tube, or trumpet, from Eustachius, the celebrated anatomist, who first discovered it.

This tube is always found in communication with the drum, and the only exception to its ordinary entrance into the throat

* Valsalva, in his book *De Aure humanâ*, ch. ii. sect. 16. has given a more accurate description of this passage to the ear than any preceding author. It is occasionally denominated *Ductus auris palatinus*, and *Iter a palato ad aurem*. Casserius, who has published an elegant drawing of it, and several of the ancients, call it the aqueduct. It does not appear that Galen was acquainted with it, and many have doubted whether Celsus had any knowledge of this duct, although his recommendation of gargles for diseases of the ear can scarcely be explained on any other supposition.

occurs with respect to the whale, in which Leviathan of the ocean it was found, by Sir Everard Home,* to open into the blowing-hole, which is furnished with a valve to prevent the admission of the water which the animal expels through this opening. From the extreme minuteness and winding course of the auditory passage,—a construction peculiar to this species of mammalia,—it has been thought highly probable, that their hearing is effected through the medium of this tube, rather than in the usual manner ; an opinion at least problematical, if not erroneous.

Riolanus remarks that even Aristotle maintained the necessity of this communication between the external air and the drum of the ear, for correct hearing.

The Eustachian tube is composed of bone

* Philosophical Transactions for 1802, Part i.
page 70.

cartilage, membrane, and muscular fibre. The bony portion, which is external and is an elongation of the tympanum, uniting with the cartilaginous, constitute a tube about an inch and a half or an inch and three quarters in length, of an elliptical figure—the area of which is about two lines in the drum, diminishing gradually to one, but near the commencement of the inner or cartilaginous part it again enlarges, and continues to do so until it reaches the throat, on each side of which it opens by an orifice sufficiently capacious to admit a goose-quill.—The osseous portion is lined with the membranous periosteum of the tympanum—the cartilaginous, with a reflection of the mucous membrane of the fauces or throat, which are so intimately blended together, that the line of their union is not perceptible.

Some physiologists believe that, in addition to its office of preserving the balance

between the external and internal ear, the Eustachian tube has likewise a decided influence in conveying sound; since, if closed, from mal-conformation or disease, deafness is the inevitable consequence. That it is indispensably necessary to the economy of the organ, may also be inferred from its guttural aperture, which forms a prominent cartilaginous edge, the convex sides whereof are turned vertically to each other, and represent a kind of half-pad, being so wisely disposed, that the air which is received through the nostrils is necessarily drawn into it. For the horns of the crescent-like termination of the tube, particularly the lower one, extend in such a manner into the inside of the nostrils, that it is impossible for the air not to strike against these horns as it passes along; and that a great part of this air being stopped, and, as it were, intercepted in its passage, must enter into the Eustachian tube; otherwise

all the air that is admitted through the nostrils would proceed directly into the cavity of the chest.

Besides the apertures of the Eustachian tube and mastoid cells, which are naturally open, two others present themselves in the interior superficies of the tympanum, directly opposite to the membrane of the drum, at which part the bone (*os petrosum*) is about the thickness only of a line. To these closed windows (*fenestræ*) it is necessary briefly to advert; because, without some anatomical knowledge of them, the reader will not be able to comprehend the explanation which will, in the next chapter, be offered relative to the function of the ear.

First, we will notice the aperture of the vestibule called the oval window (*fenestra ovalis*) which was first noticed by Fallopius, who supposed that it opened into the labyrinth. The second opening is

named the round window, (*fenestra rotunda*,) and leads into the cochlea. Both these apertures are closed in the living subject by the periosteal lining of the tympanum. The *fenestra ovalis* or *foramen ovale*, denominated by Casserius *fenestra labyrinthi*, is placed in the upper and outer part of the internal superficies of the tympanum, parallel with the plane of the *membrana tympani*. It exactly resembles the base of the stapes, by which it is completely closed, admitting however of some slight motion.

The *fenestra rotunda* or *fenestra cochleæ* is situated lower than the former, and farther from the mastoid cells;—its aperture is less than that of the former, and closed by a membrane somewhat of an oval figure. Scarpa* considers this round window as equivalent to another mem-

* Scarpa de *fenestra rotunda* 1772.

brana tympani, which indeed it nearly resembles, being, like it, convex internally. Diminutive even in the adult, it is, as Cassebohm observes, much more so in the infant state.—We shall only further observe that the cavity of the human drum contains the four small bones of the ear termed ossicles (*ossicula auditûs*,*) each having a name affixed to it expressive of its peculiar shape.

The ossicles are distinguished by their diminutive size and elegant form. They are the only bones in the body which have attained their full size, complete form, and perfect ossification, at the period of birth.

* Fallopius asserts that Galen and the antient Greek anatomists were entirely ignorant of these small bones; and adds that the two first (*malleus* and *incus*) were discovered by *Jacobus Carpensis*, the earliest restorer of the art of Anatomy which was afterwards perfected by *Vesalius* who gave them their present names. The fourth bone, the *stapes*, was originally observed by *Ingrassias*, a learned Sicilian physician; and *Sylvius* discovered the *os orbiculare*.

Their structure in relation to their chief constituent parts is uniform, but deviations in shape are by no means uncommon.

These bones are — 1st, the mallet or hammer (malleus): 2nd, the anvil or stithy, (incus, or dens): 3rd, the lenticular bone (os orbiculare)—which is the smallest bone in the body, being considerably less than a grain of sand, or mustard-seed, and may with propriety be considered as an inter-articular bone : — 4th, the stirrup (stapes or stapha), the iron part of which it strikingly resembles. Vesalius compares it to the Greek letter Δ (Delta). It is very elegant in its formation, and possesses a peculiar and determinate figure, from which it derives its usual and appropriate name. Its base is not perforated; but the edges of it correspond with the opening of the fenestra ovalis, which it nearly closes, and where it is confined by the membranous lining of the tympanum and that of the ves-

tibule,—being, like the membrana tympani, placed between two membranes, but having some degree of motion which connects it so exactly that it cannot possibly be either sunk down into the cavity which is at the bottom, or raised to the top of the fenestra, without breaking the window. Cuvier* found that the stapes is nearly solid in whales, (cetacea,) and that there is no perforation in that of the walrus, a peculiarity which seems to belong to such mammalia as live in water—the seal possessing it also in some degree.

The ossicles form an uninterrupted chain across the drum, stretching from the membrana tympani (to which the handle of the mallet is attached) to the fenestra ovalis of the labyrinth, which is closed by the base of the stapes ; and their mechanism is

* Leçons d'Anatomie Compar. tom. 2. p. 505.
Also Philosoph. Transactions for 1805.

such, that whilst they transmit the vibration, they at the same time strengthen the impulse of sound. These ossicles, which, as we have said, are all perfect at birth, are articulated with each other by capsular ligaments of a degree of tenuity proportioned to their minuteness. They are invested with a fine vascular membrane or periosteum (of which a beautiful delineation is given by Ruysch), from which numerous little vessels proceed and penetrate their substance for the purpose of supplying them with nutriment. Cassebohm states that he has seen black spots upon the incus proceeding from caries—similar to what frequently occurs to the teeth. He also declares that he has discovered matter in the incus, and has even witnessed, in one instance, an exostosis or excrescence of the same bone.

To these ossicles diminutive muscles are attached ; two to the mallet—a tensor and

laxator—and one to the stapes; which seem to regulate their motions, and adjust the whole series to the several modifications of sound, hard or soft, harsh or grateful. The membrana tympani is crossed by the branch of a nerve called the corda tympani.

But as minute anatomy is not the object of the present undertaking, I shall not dwell at greater length on the contents of the drum—the more especially, because the parts under consideration, as well as the third division of the ear—the labyrinth—cannot be fully comprehended by any verbal description, and, as far as relates to disease, lie too deep for domestic treatment.

SECT. III.—*Of the Labyrinth or internal Ear.*

We have now carried our brief survey as far as the middle division of the ear, and in the prosecution of our inquiries, are about

to take a glance at the third or most internal part of that organ, designed for the reception and ultimate distribution of the auditory nerve.

This portion of the ear, called, on account of the intricacy of the canals and cavities composing it, the labyrinth, is the immediate seat of the sense of hearing. It is situated at the inner part of the cavity of the drum; and incased in the petrous part of the temporal bone, with the existence of which the ancient Greeks, Arabians, and Romans, were wholly unacquainted.

The labyrinth is almost as large in children as in adults (whereas the internal ear of fishes grows with their growth); and its substance is not less complete and hard, whilst the osseous matter surrounding it is soft and spongy. It may therefore be easily detached and separated from the rest of the petrous part of the bone, either before, or at an early period after birth. But in

adults, all the parts are so completely consolidated, that even the semicircular canals present the appearance only of fine tubes or passages formed in a piece of bone, hard and compact as ivory.

All the cavities hitherto described contain air, and communicate with the atmosphere; but in the several cavities of the labyrinth, there are membranous sacs and tubes corresponding with the form of the bony cavities, on which are expanded the pulpy extremities of the auditory nerve, which are themselves filled with and surrounded by an aqueous fluid called the water of Cotunnius.*

Under the term labyrinth is comprehended the vestibule, the three semicircular canals, and the cochlea, so called from its resemblance to the shell of a common snail.

* Cotunnius, de aquæductibus auris humani, Neapol. 1760.

The celebrated Morgagni, of Pavia, who wrote a master-piece on the structure of the ear as far as it was at that time known, and such of the earlier anatomists as were acquainted with this portion of the organ, deducing their opinion from the dry bone—considered the several cavities to be simply subservient to the reverberation of sound, being entirely ignorant of the membranous texture on which the sentient extremities of the nerve of hearing are finally distributed.

This important discovery was first made by Dr. Meckel* of Berlin, and the parts have since been more minutely described by Professor Scarpa,† who ascertained the

* *Dissertatio de Labyrinthi Auris contentis*. Argent. 1777;—a work of the greatest merit.

† Scarpa, *de Fenestra Rotunda* 1772. and the *Disquisitiones Anatomicae de Auditu et Olfactu* 1789. both of which publications do great credit to the inge-

existence of this peculiar structure in fish and the amphibia ; in which the membranous canals and vestibule, being much smaller than the bony or cartilaginous cavities wherein they reside, can be more easily distinguished and demonstrated than in the mammalia and birds, in which they are closely surrounded by bone.

But in a practical point of view it is unnecessary, and indeed it would be impossible, to convey to the general reader a correct idea of the exquisitely delicate and complex structure, as well as minute and curious mechanism of the labyrinth, by any verbal description—without the aid of plates and anatomical preparations. It was doubtless with this impression on his mind, that the learned anatomist Albinus,* after beginning

nious author : the engravings in the latter are executed with unrivalled elegance.

* Much information may be obtained on this point from the fourth book of Albinus's *Annotiones Ana-*

very formally a chapter on the ear, abruptly concludes the subject in a few words, and refers for further explanation solely to the bones themselves, and to his detailed delineations of these complicated parts.

Dismissing, therefore, as incompatible with our object, a more precise consideration of this intricate portion of the auditory apparatus, I will only add that the nerve, the pulpy extremities of which are expanded upon a fine membranous texture, and float also (according to the opinion of some late physiologists), in the fluid of these cavities (*aqua Cotunnii*), throughout the different cavities of the labyrinth, is destined to receive, by means of the more external parts of the organ already described, the vibrations of sonorous bodies from which

tonicæ—as well as from Munro's Observations on the Nervous System.

a sensation is experienced proportionate to the force or weakness of the impression ;—rendering us (by a law altogether mysterious and inexplicable) sensible to the infinitely diversified varieties of sound.

From the preceding slight and cursory description of the organ of hearing, it will readily be admitted that few parts of the animal economy afford a more attractive object for minute investigation—both on account of its admirable and elaborate structure; and the great importance of its function ; to which we may add, the numerous morbid affections to which it is occasionally subject. Accordingly, it has been accurately examined during the last two centuries by several deservedly celebrated anatomists,—to whom we have already adverted, and to whose writings I must refer those who are anxious for fuller information on the subject ;* and in point of fact

* The great and modest Fallopius was the first anatomist who entered upon the investigation in a proper

we possess more accurate and detailed

manner; and having discovered most of the important points in the structure of the ear, has described them with great fidelity in his valuable *Observationes Anatom.* 1561.

The *Epistolæ de Auditûs Organis* of Eustachius are contained in his *Opuscul. Anatom.* published at Venice in 1564. At the close of the sixteenth, and in the beginning of the seventeenth century, much additional light was thrown on the structure of the ear by the contemporary labours of several other eminent anatomists—amongst whom may be mentioned, Duverney in his *Traité de l'organe de l'oreille*, 1683; and particularly Valsalva in his *Tractatus de aure humanâ*, an extraordinary work, the result of sixteen years of indefatigable labour, in the prosecution of which the author is said to have dissected and examined no fewer than one thousand human skulls! The valuable works of Valsalva were edited by his friend Morgagni at Venice in 1740, accompanied with eighteen Epistles of the editor's own, chiefly relating to the ear. Vieussens, who was a rival of Valsalva, published a laboured work on the subject at Toulouse, in 1714, under the title of *Traité nouveau de la Structure de l'Oreille*.

But Cassebohm, a German anatomist, outstripped

descriptions of the ear than of any other portion of the human body.

all who had gone before him both in unwearied industry and successful research relative to the structure of the human ear—particularly in tracing it from its very earliest formation. Accordingly, his *Tracti di Aure humanâ*, Halle 1734-5, exhibit a model for such enquiries, which it is perhaps impossible to excel. Last, not least, should be mentioned a work equal, if not superior, to any that preceded it, and which appeared in Germany from the pen of the celebrated Soemmering, so late as the year 1806. It contains a series of most elegant and faithful engravings of the anatomy of the whole organ, executed in so chaste and correct a manner, as justly to entitle both author and artist to the highest honour and credit.

Besides the above, and many other authors who might be named as having distinguished themselves by their description of the *entire* human ear, there are several who have produced excellent treatises on individual *portions* of the organ,—for instance, Cotunnius, Meckel, Scarpa, Monro, &c. &c., to some of whom I have already referred.

CHAPTER III.

OF SOUND AND THE SENSE OF HEARING.

HAVING taken a very cursory view of the anatomical structure of the several parts of the human ear, we shall now proceed to its physiology. Before we can duly explain or appreciate, however, the subserviency of the individual portions of the auditory apparatus to the function of the entire organ, it will be expedient to offer a few general observations on the nature of sound, the immediate object of this sense.

Sound is not, like light, self-existent. The epithet is applied to the perception

excited in the mind by the vibrations of an elastic body impinging upon the membrane of the drum, and thence conveyed to the auditory nerve expanded in the labyrinth. The science of sound, as producing melody and harmony, is extremely curious and interesting; since, from the succession of sounds or notes, and their consonance, results a language for which words are no substitute; this branch of the subject, however, furnishes matter too copious for our present investigation.

All substances, the particles whereof are susceptible of a certain degree of resistance or reaction, are capable by percussion of exhibiting the phenomena of sound. When a sonorous body is struck, its component particles suffer a sudden collision, or have a motion or oscillation communicated to them, as is rendered manifest by the trembling that may be felt on placing the hand upon a large bell vibrating from the stroke

of a clapper. Every part of a body which produces sound, trembles or vibrates in such a manner as alternately to elevate and depress its plain surface into the form of arches or curves, denominated sonorous waves; as is exemplified by an extended string of a violin, which, when put into motion by the bow, is known to be curved here and there an infinity of times in a very short period.

The transferring medium receives these tremors either from some body striking against it, or from the medium itself impinging against some other body; or lastly, from the collision of two bodies against each other.

Elastic air is the principal means of transferring sonorous tremors,—for sound is not perceptible *in vacuo*, as may be proved by ringing a bell in the exhausted receiver of an air-pump, in which, if there is no air, the bell will not be heard.

The undulations which produce sound, consist only of a series of aerial particles, by which vibration is transmitted from the sonorous body to the ear. These particles are affected by the vibrations imparted to them, and they change place and figure with greater facility the nearer they are to the body struck; for sound becomes more faint and less audible according to the increase of distance; or more correctly speaking, it diminishes in the ratio of the square of the distance.

In order to comprehend the manner in which air becomes the vehicle of sound, we must consider the atmosphere as an elastic fluid, which, like water, is capable of being thrown into undulations. Thus, for example, suppose a stone to be thrown into the bosom of a calm unruffled lake, a series of waves will result therefrom, which will extend further and wider in proportion to the impetus with which the stone has been

projected. Imagine, then, that the voice produces in the air an effect similar to that which the stone excites in the water. Whilst the person who speaks is uttering a word, he expels with more or less force the air out of his mouth, imparting thereby an undulatory motion to the particles of air in immediate contact with his lips, which motion is communicated by successive undulations to the ear. These oscillations or impulsions of the air are required, however, to succeed each other with a certain velocity; and in order to render them audible, they must not be fewer than thirty in a second.

The force of sound depends entirely upon the extent of vibrations that the particles of a sonorous body suffer. Acute or grave sounds arise from a greater or lesser number of vibrations in a given time. But the vibrations will be so much the more frequent as the sonorous body may have less

diameter and extent. The diversity of sounds from a harp, and in general from all stringed instruments, depends upon the inequality of the length, diameter, and tension of their respective strings—facts well understood by persons conversant with music. The sound thus produced, whether acute or grave, strong or weak, is carried through the air with a velocity equal to 1130 feet in a second, or about thirteen miles in a minute, unless opposed by a contrary wind, which considerably retards its progress. Density and dryness of the air increase sound, whilst rarefaction and moisture lessen it. Hence in summer, sound moves quickest; and in Guinea it has been calculated to pass at the rate of 1170 feet in a second. That the condensed state of the atmosphere affords an easier communication of sound, and renders it proportionably louder, is satisfactorily elucidated by the following fact. Stermius

relates that a diver blowing his horn in his diving-bell at the bottom of the sea, the sound in that compressed air was so distressingly loud, that it quite stunned and made him so extremely giddy, that it was with the utmost difficulty he could preserve himself from falling into the water.

The force of sound, as well as the brilliancy of light, may be augmented by concentrating the undulations of the former, and converging the rays of the latter. On this principle, hearing trumpets are constructed, which are found particularly serviceable for assisting slight deafness.

Again,—sonorous undulations, striking a hard body that obstructs their direct motion, are reflected, like light, at an angle equal to its incidence, and with a velocity proportioned to that wherewith it impinges against the solid substance—whence arises a secondary vibratory motion, increasing the primary one. From these data, archi-

tects have constructed buildings remarkable for their power of augmenting weak sounds; such are the whispering gallery of St. Paul's, and the whispering place in Gloucester Cathedral. But when these secondary sounds, produced by the percussion of a body more or less distinct, reach the ear later than the primary ones, they constitute what is called an Echo,—a phenomenon beautifully allegorized by the ancient mythologists, who make it the daughter of Earth and Air—in order to produce which, however, an interval is required of six-thirds of time, or the distance of 55 feet between the echoing body and the air.

But air is by no means so good a conductor of sound as water. It was once an axiom among naturalists, that to suppose fishes to have ears, would be to conceive that Nature had bestowed upon them an useless organ—since it was generally believed that water was a non-conductor of

sound. But Mr. Boyle assures us that on the tinkling of a bell fishes came to be fed; and in the Royal Academy of Sciences, we are told that it was customary for the fishermen on the coast of Brittany to beguile the fish into their nets by the beating of drums, as the islanders of Scotland are in the habit of doing when the larger fish get entangled among the rocks. In China, the gong is used for the same purpose. These facts, in proof of water being a medium capable of transmitting sound, and of fish possessing the power of hearing, were once of consequence; but more accurate observations on the subject have now rendered them of only secondary importance.

The Abbé Nollet has set this question at rest; for, after considerable preparations, by which he acquired a dexterous management of himself under water, he found that he could hear the human voice

when immersed in that element, and could even distinguish conversation and music.

The human ear, however, is an organ ill adapted to this medium of sound, and consequently these experiments do not inform us of the relative powers of water and air in the propagation of sound. But another of the Abbé's experiments proves—what indeed might be inferred from the structure of the ears of fishes—that water transmits a much stronger vibration than air. For, when he sank under water, and struck two stones together, the collision gave a shock to his ear which was almost insupportable, and which was felt like that sensation produced when a solid body suspended on a string and held by the teeth is struck by another solid body. He observed, likewise, that the more sonorous the body struck, the less vivid was the impression—from which it would appear that water, though it conveys an impression

more strongly to the ear than the atmospheric fluid, is not equally adapted to the resonance and variety of tone.

But solid substances convey sound still better than the aqueous medium, as is evinced by the simple experiment of placing the head in close contact with the extremity of a piece of timber thirty feet in length, at which distance the perfect organ will be able to hear if you only scratch the opposite end.

Mr. Clough, late of Manchester, has made some ingenious experiments, from which he infers that the cranium or scull is a really sensible solid. We know, indeed, that a watch held betwixt the teeth, or even applied to the head, can be heard by a person who is deaf to impressions conveyed through the air. It is partly in this way that we can judge whether deafness may be cured by an operation, as depending on some injury of the mechanism of the

organ, or whether it be an incurable affection of the nerve or brain itself. For, if the sound be perceptible when conveyed through the teeth, or when a watch is pressed against the mastoid process, we are assured that the internal organ is unaffected, which assurance may lead us to detect the seat of the disease to be either in the outer passage of the ear, the drum, or the Eustachian tube,—and to regulate our measures accordingly.

Enough, I conceive, has been advanced on the nature of sound as applicable to the phenomena of hearing, beyond which it would be foreign to my present purpose to enlarge. We will therefore next proceed to explain the adaptation of the ear to the perception of sound; for in vain might the air, agitated by sonorous bodies, impinge upon us from all quarters, were we not furnished with an appropriate organ to receive their impression.

The object of the organ of hearing being to receive and convey the elastic tremors or impulses of the air to the brain for perception by the mind, we observe the auditory apparatus composed in a very different manner from that of any other of the senses, it being formed chiefly of hard bones, elastic cartilages, and membranes, which are perfectly adapted for the reception and communication of the necessary tremors.

When aerial undulations were first proved to be the cause of sounds, philosophers looked no further to the structure of the ear than to discover parts fitted to be acted upon by such vibrations. Remarking the structure of the membrane of the tympanum, and its admirable capability for receiving these motions of the atmosphere, they were satisfied, without considering the immediate objects of sensation ;—much as an ignorant person, at the present period, would rest content with knowing the fact

that sound is received upon the drum of the ear.

But, after having given a cursory anatomical description of the ear, it will prove interesting and instructive to take a general survey of a structure as beautiful as any that the mind can contemplate. We cannot assert that it surpasses in beauty the structure of some other parts of the body; but the parts are adapted to each other in a manner so perfect, simple, and at the same time efficient, that we can better understand and appreciate their harmony than that of organs which perform their functions by powers and actions almost entirely unknown to us.

We have already explained the organ of hearing, in the higher orders of animals, to consist of three distinct parts—one placed externally, for the purpose of collecting and transmitting sonorous undulations, which are modified in passing through the interme-

diate cavity (the drum) to the interior parts called, collectively, the labyrinth, where the nerve destined for the reception of sound and its transmission to the brain is situated. We have likewise shown the opinion of the ancients relative to the expansion of the nerve in the tympanum, which they believed to be the seat of hearing, to be fundamentally erroneous.

The external apparatus, with its many eminences and depressions, is formed, as we have observed, into curvilinear grooves, all tending to one common opening, which, like a hearing trumpet, is admirably adapted to collect, and, on the principles of mechanics, to direct the pulses of the air inward to the cavities of the ear. The two little protuberances, the tragus and anti-tragus, which are of a texture softer than that of the helix, serve gently to blunt, not forcibly to repel, sound in its progress toward the auditory passage. The elasticity

of the auricle, added to its naturally forward position, serves to augment the force and intensity of its tremors—a power increased, especially in timid animals, such as the hare and others, by the auricular muscles attached to and rendering it occasionally more tense.

We may in this place just remark, that when the necessities of what are termed the lower animals demand that they should be better provided with this external appendage than man, the superiority is only manifested with regard to the simple perception of sound—while the human subject, from the greater perfection of the internal machinery, added to the agency of his rational and intellectual faculties, surpasses all the animated creation in the capacity of his ear for the reception of articulate and musical sounds.

The sonorous waves of the elastic air being driven into the cartilaginous funnel

of the ear (which is not, however, in man, whatever may have been advanced to the contrary by Boerhaave, sufficient to concentrate all the rays which impinge against it) are repelled and accumulated by alternate reflections from its elastic surfaces into the cavity of the concha, whence they pass into the auditory tube, the tortuous course and contracted area of which reflect and condense them, while the tremulous motion excited in its osseo-cartilaginous parietes contributes very much to increase their force. The rays of sound thus conveyed inward by the trumpet-like tube, impinge upon and cause to vibrate the fine elastic semi-transparent membrane somewhat resembling the parchment of a drum, which is expanded between the bottom of the auditory passage and the tympanum, or drum—a cavity containing elastic air, and the four ossicles.

These small bones, which are articulated

together by capsular ligaments of a tenuity bearing a proportion to their diminutive size, and possessing some degree of motion between themselves, form an uninterrupted chain of communication across the tympanum between the outer passage and the interior parts of the organ, by the adhesion of the whole length of the handle of the malleus to the membrana tympani, and the basis of the stapes to the fenestra ovalis. From the attachment of the malleus, it is evidently intended to receive the oscillations of the membrana tympani, and from the articulation of the head of that bone to the incus, the tremors impressed upon the malleus by the membrane of the tympanum, must be communicated to the incus with increased energy. For, the centre of motion of the incus is in a line drawn through the middle of its body; and consequently, the extremity of the long process to which the stapes, through the intervention of the os orbiculare is attached,

moves through a greater space than that which receives the impulse of the head of the malleus—and, of course, this mechanism of the bones essentially assists in giving strength to the vibrations which are transmitted to the labyrinth, containing the sentient expansion of the auditory nerve.

The os orbiculare is merely an inter-articular bone, the use of which is to promote the accurate and perpendicular motion of the long bone of the incus upon the head of the stapes. For, if this bone had not been so placed, the motion of the long lever must have given an obliquity to the impulse upon the stapes, the basis of which fills up the foramen ovale.

The stapes lies inclined, and is covered by its own muscle, which seems to act upon it that it may lie higher up under the back of the fenestra ovalis, by which position, and by acting like a piston on a membrane of much less circumference than that of the

membrana tympani, the contents of the vestibule are pressed. From all which circumstances we may learn how much and how strongly the agitation of the air in the outer canal of the ear is increased before it strikes upon the fluid contents of the labyrinth.

Small muscles are also attached to the exterior and interior ossicle:—one of those belonging to the malleus is called the tensor, by means of which the membrane of the tympanum is stretched, and better disposed for our hearing weak sounds; whilst another, the laxator, serves to moderate those sounds that are too violent by drawing the malleus from the incus, by which means the propagation of sonorous vibrations is interrupted.

The other muscle being inserted into the stapes, and not into either of the middle bones, it would appear that the operation of these muscles is chiefly upon the membrane of the tympanum and that of the for-

men ovale, through the medium of the bone immediately attached to each. Their office is therefore, no doubt, to extend or relax the membrane with which they are respectively connected, and thus to adapt the organ of hearing to the force or weakness of the sound which strikes it. In a similar manner, the iris, by a contraction or dilatation of the pupil, accommodates the eye to light, and admits a greater or lesser number of rays, according to the impression they produce. The pupil is contracted or dilated in order to receive an image in the greatest perfection, and without the least injury to the organ. The membrane of the tympanum is extended or relaxed, likewise, to transmit to the hearing perfect vibrations, and such as are proportioned to this organ.

When the ear is assailed by the impulse of too violent a sound, this membrane, whose concavity is sunk inward, is pushed in an

outward direction by the spring which terminates in its centre. By this mechanism the membrane is relaxed, which relaxation diminishes so much of the impetuosity of the sound as might be capable of hurting the organ.

On the contrary, when the sound is too feeble, the first spring or muscle draws the membrane of the tympanum inward, rendering it more extended, and consequently more susceptible of agitation. The other muscle opens the second sinus, and facilitates the motions of the internal parts.

In sounds whose nature is of a medium between the two preceding extremes, the membrane of the tympanum likewise preserves a middle tension, by which it is adapted to these modified sounds, and, as it were, in a state of unison with the vibrations of the air.

Hence, the trembling of this membrane communicates the sound to the inner parts

of the organ in a manner more complete and perfect. And it is probable that the justness of the ear in music depends partly on the regularity of the motions of the muscles of these little bones, in order to dispose exactly and readily the membrane of the tympanum to an unison with the tones it receives.

Rohault observes that, when we listen attentively, it is nothing else than stretching or relaxing the membrana tympani agreeably to the exigency of the occasion, and thus keeping it in that state in which we can most conveniently receive the motions of the external air. The more ready hearing of deaf persons through the agency of loud noises, or in a carriage, is another argument of the use of the straining or relaxation of the membrana tympani. Dr. Willis mentions his having been credibly informed of a woman who was exceedingly deaf, yet could distinctly hear any words.

which were spoken while a drum was beating in the chamber ; and that her husband, on that account, kept a drummer for his servant, in order that he might be enabled at any time to hold conversation with his wife. Do not such facts present a strong proof of the internal muscles of the ear being in some degree voluntary, or under the controul of the will? If it be otherwise, how shall we account for the ear not suffering any particular inconvenience from a loud noise of which we have been previously apprised ; whilst, on the other hand, a person is rendered temporarily deaf, and experiences the most disagreeable sensation, if, instead of a whisper (which he had expected), the organ is suddenly assailed by the impulse of a violent sound, such as the discharge of a cannon—the nerve being exhausted for awhile of its sensorial power by the vehement noise applied at a time the tensor muscles were in powerful action.

But, as Aristotle maintained in opposition to the opinion of Galen, the membrana tympani could not vibrate without the presence of air in the tympanum, any more than the parchment of a drum unless a hole were left in its side. This cavity is therefore furnished by means of the Eustachian tube with that elastic fluid, which, warmed in its passage through the nose and the tube, equipoises in the barrel the weight of the atmospheric air on the outside of the membrana tympani, when impelled against it with unusual impetuosity by the more violent sounds. In inspiration, the air presses the membrane outward; and from thence proceeds that clashing or whispering noise by which the hearing is obscured in the act of yawning; for then the air, entering more abundantly through the tube into the tympanum, resists the tremors of the external air.

When this air is pent up, from the in-

inflammation of the membrane of the Eustachian tube, or from its closure by adhesion, the included air, incapable of yielding except by condensation, counterbalances the pulses excited by sounding bodies; or becoming absorbed, the unresisted pressure of the atmosphere forces the membrana tympani as far inward as it is capable of receding—in which position it will remain stationary, and cannot vibrate but in a trifling degree. Either supposition explains the cause of the great loss of hearing consequent upon an obstruction of this tube.

In the bottom of the tympanum there are, as we have seen, two openings—the fenestræ ovalis and rotunda; both of which lead into the labyrinth—one of them into the scala of the cochlea, the other into the vestibule. In the labyrinth, as already observed (p. 55), instead of the implanted air spoken of by Duverney and others, we find an aqueous fluid surrounding a membranous

texture—a medium which has been shown to convey a stronger impulse than the atmosphere, stronger in proportion to its greater specific gravity and want of elasticity; for an elastic fluid like air may be compressed; but an inelastic, or one nearly so (as water), must transmit entirely every degree of motion it may receive.

But if the fluid of the labyrinth be surrounded on all sides; if, as is really the case, there is no free space in the labyrinth; it can partake of no motion, and is ill suited to the oscillations of sound. Against this perfect inertia of the fluid of the labyrinth, the fenestra rotunda is probably provided: The foramen ovale receives the vibrations from the bones of the tympanum, which circulate through the intricate windings of the labyrinth, and are again transmitted to the air of the tympanum by the fenestra rotunda. For, without such an opening there could be no circulation of the vibra-

tions in the labyrinth, inasmuch as there would be an absolute and uniform resistance to the motion of the fluids. The air of the tympanum, having a free egress, cannot strike the membrane of the fenestra rotunda with any considerable force—or, at least, with an impetus in any degree comparable to that which is impressed upon the fenestra ovalis by the machinery of the ossicles and internal muscles of the ear: it cannot therefore be thought capable of opposing the stronger vibrations which circulate from the fenestra ovalis through the labyrinth. Indeed, the supposition (though advanced by the ingenious Scarpa) would involve the necessity of a double direction in the motion of the fluid in the labyrinth, a circumstance so far from increasing the effect, that it would tend, by antagonizing, to annihilate the vibrations of both foramina.

The vibrations thus transmitted through

the membrana tympani and chain of bones to the membrane which closes the fenestra ovalis, are communicated to the aqueous fluid that occupies the different cavities of the labyrinth, in which the soft delicate nerve—the sensitive part of the organ—is expanded on a pulpy receptacle, which being collected into one trunk, conveys the impression to the brain, and thus completes the connection between the external agent and the sensorium.

But in what manner vibrations propagated as above described excite in the brain the perception of sound, and the phenomena of hearing, is an unrevealed mystery equally incomprehensible and inexplicable. As to the immediate seat of the sense, there cannot, after what has been stated relative to the distribution of nerves, remain any doubt or controversy; though before the structure of the ear was well understood, some imagined that the tympanum,

others that the vestibule, or the middle part of the semicircular canals, was the seat of hearing—whilst many contended that the lamina spiralis of the cochlea was better adapted for receiving the impression of sound. It is evident that the soft expansion of the nerve in all the three divisions of the labyrinth is intended to receive the undulation of the contained fluid, and that this motion of the fluid gives to the nerve and ultimately to the brain the peculiar sensation of hearing.

In further illustration of what has been advanced, we will cursorily inquire into the relative importance of the different parts of the auditory apparatus to the function of the ear, since we know that all are not *equally* necessary to the mere perception of sound.

When we reflect on the various and important services performed by the sense of hearing, we shall naturally expect to find

an organ subservient to this purpose in most classes of animated beings. Accordingly, red-blooded animals, without exception, possess the auditory apparatus. In some of the white-blooded, also, analogous parts are found; and others certainly can hear, although the organ appropriated to that function has not hitherto been ascertained.

In the different gradations of animated existence, where an organ of hearing has been discovered, it assumes a variety of shapes, both in its appearance and organization; some parts of which are uniform, others found only in particular classes, and even in creatures of the same class differing in conformation. The obvious inference is, that the parts universally found are the *essential* means by which sound—be the sense of it delicate or imperfect—is perceived, and that the additional apparatus is intended only to *facilitate* its transmission

and to *modify* its action. The whole of the machinery exterior to the labyrinth is not absolutely necessary to the simple perception of sound, since many creatures, we know, are susceptible to the impression which are nevertheless destitute of the accessory parts of the organ.

Man, together with most of the mammalia, is distinguished by the external appendage of the auricle, which nevertheless must not be considered, even in them, as indispensable to the economy of the ear, since it has been removed in all with the effect only of impairing the powers of the organ for a time. There is as little ground for believing the idle notion formerly entertained by several naturalists and physicians, that cutting off the auricle rendered persons unprolific—an idea which first induced legislators to direct the ears of thieves to be excised or amputated, lest they should multiply their race.

If the meatus externus be entirely obliterated from original malformation, complete deafness exists. The sense of hearing is also rendered exceedingly defective by the formation of an artificial membrane, shutting up the passage into the ear, as well as by an accumulation and inspissation of cerumen ; facts proving the importance of the meatus externus to the due exercise of the function.

The perfection of the membrana tympani, however, with which all the mammalia are furnished, is not essential to hearing ; a fact well known to Riolanus, Bonetus, and Willis. For though it undoubtedly is, on many accounts, highly serviceable, and by receiving and increasing the tremors of the external air, renders the slighter impressions audible, yet we know, from ample experience, that when deprived of it by disease, man still enjoys the sense and is capable not only of perceiving the

distinctions of articulate sounds, but even retains his musical ear. The use of the *membrana tympani* is not indeed so much to give delicacy or correctness of hearing, as to regulate the impressions of sound, and to proportion them to the expectations of the organ.

The value of each particular form of the *tympanum*, or middle cavity of the ear, which varies exceedingly both in size and shape in different instances, cannot well be determined; and, as it is wanting only in fishes, insects, and most of the serpent tribe, which have nevertheless the power of hearing, it cannot be considered indispensable to the economy of the organ. But wherever a *tympanum* exists, we never fail to discover an Eustachian tube, which is therefore unquestionably subservient to it, as it seems necessary that air in the *tympanum* should be occasionally changed, which is perhaps accomplished by some

action of the fauces, and by the action of the circumflex muscles of the moveable palate, forcing a new body of air into the Eustachian tube,—the innate air so much talked of, and so little understood by the ancients, being useless for the purpose of hearing.

Some physiologists have thought that the air contained in the tympanum conveyed the pulses of sound to the labyrinth. Others have fancied that it actually gave passage to the rays of sound—which they attempt to prove by stating the following well-known facts; first, that when we listen attentively, the mouth is unconsciously open; and secondly, that sonorous bodies vibrating between the teeth make an unusually loud noise. They imagine that, in these instances, sound passes from the mouth into the throat, and thence, through the Eustachian tube, into the tympanum; and they erroneously assert, by way of

proof, that the frog receives sounds through the mouth, into which the Eustachian tube opens. But, in the former case, by depressing the lower jaw, the condyles which are placed anterior to the meatus externus, descend and are carried forward, and consequently enlarge the area of that canal, as may be easily ascertained by introducing the finger into the ear, the moment this motion is performed.

That the sole use of the Eustachian tube is to change the air of the tympanum, and that it is not capable of conveying sound to the ear, is evinced by the following experiment. If you put a watch into your mouth, without touching the teeth with it, and at the same time close the meatus externus, no sound is heard.

In the class of amphibiæ, there are no lateral cells answering to the mastoid; but in the elephant and owl, they are uncommonly large; and as the sense of hearing in

these animals is remarkably acute, we may infer that the use of the lateral cells is to co-operate with the tympanum, (of which they may be considered a prolongation,) in transmitting and augmenting the force of sound.

The ossicles, or four bones of the tympanum, have been considered either as a series of conductors to propagate sonorous vibrations, or else as a means of giving tension to the membrana tympani and membrane of the fenestra ovalis,—both which offices they probably perform under certain circumstances.

When they have muscles attached to them, as in man and the mammalia, they probably perform the latter office, and become the regulators of sound. But in those animals wherein they do not exist, and in birds, whose fenestra ovalis is quite shut up with bone,—all of which, instead of four ossicles, have only a single opercu-

lum connected to the two membranes,—this operculum can serve only to continue the vibrations imparted to it.

The dislocation, or indeed the complete destruction, of the three outer ossicles does not necessarily cause deafness ; the result is only a diminution and sense of confusion in the perception of sound. But the removal of the stapes occasions total and incurable loss of hearing, in consequence of the evacuation of the fluid contents of the labyrinth. Ossification, also, of the fenestra ovalis, Valsalva ascertained to produce irremediable deafness. These facts, added to that of the stapes being uniformly found in all animals having an ear, prove it to be of the very highest and indispensable importance.

The fenestra rotunda is decidedly subservient to the cochlea, being present only in those instances where that part of the labyrinth exists ; and from the office we

have already presumed to assign it, we cannot but regard it as essential to the perfection of the auditory function.

And though it should seem that the vestibule alone is sufficient to receive the impression of sound in some animals, and that in many the vestibule and semicircular canals form the sole organ of hearing,—yet we must conclude that, as the cochlea is fully perfected in man and in quadrupeds only, it is subservient to the most exquisite sensation. Not that the cochlea, or any part of the organ, conduces exclusively to the bestowing of a musical ear. Birds, which have the cochlea very imperfect, are notwithstanding the most musical of the whole creation; though this quality in them, as we before noticed, must proceed more from the disposition of their throat than the delicacy of their ear. Although we ourselves are capable, by hearing, of the perceptions of melody and harmony,

yet these depend chiefly upon the mind, and are not confined to any specific operation of the organ, since they are enjoyed, as Dr. Reid observes, in a very different degree by those whose simple faculty of hearing is equally perfect.

The aqueducts doubtless serve the purpose of carrying off the superfluous lymph of Cotunnus, when too copiously secreted by the vascular periosteum of the labyrinth. This fluid is, in due proportion, indispensable to the mechanism of the ear, as it is found in all animals possessing the organ — whether its use be to keep the nerve in that state of softness and humidity necessary for sensation, or whether it merely transmit the undulatory motion by which it is agitated. The deafness of some persons was found by the late Mr. Cline to be owing to a caseous substance occupying the place of the water in the labyrinth. And the total loss of hear-

ing of old people, which, according to some authors, results from the blunted sensibility of the auditory nerve on account of repeated and long-continued impressions having exhausted its excitability, (as is frequently the case with smiths and artillerymen,) seems to be sometimes occasioned by a want of this fluid, and a consequent dryness of the internal cavities of the ear. For, during the severe winter of 1798, Professor Pinel, at the Hôpital Salpêtrière, having caused the crania of several individuals, who died at an advanced age and had lost their hearing some years, to be opened, found the cavities of the labyrinth completely empty, though the fenestræ were entire. In younger persons, who had possessed the faculty of hearing, they were filled with a cake of ice.

Finally, — with respect to the auditory nerve, which is expanded throughout the three divisions of the labyrinth upon a soft

and delicate membranous texture formed into distinct sacs and tubes,—there can be no question that, in order to our possessing the full power of the organ, it is essentially necessary not only that the external parts be in a healthy condition, but likewise that no cause exist capable of deranging the function of the portio mollis of the seventh pair of nerves—the immediate seat of the sense of hearing. This is rendered manifest, by the circumstances already mentioned relative to the diseased state of the labyrinth; and is still further illustrated by the nerve being rendered torpid on exposure to intense degrees of cold; or paralytic from compression or concussion of the brain (affecting its origin), or by tumors more immediately influencing the trunk of the nerve—as well as by other causes so obscure and recondite as to elude our acutest anatomical research.

To conclude:—It is impossible, I con-

ceive, to explain, as Willis has ingeniously attempted to do, on the principles of mechanism alone, the operations of the different varieties of structure in the organ of hearing; or the effects of strong or weak sounds in the production of all the wonderful phenomena of this most useful and exquisitely curious sense.

After all that we have stated on the economy of the ear, and after studying with all diligence its anatomical structure, we cannot but be astonished at the wonderful varieties to be found in the sensation; for the ear, as Reid observes, is capable of perceiving 4 or 500 variations of tone, and probably as many different degrees of strength. By combining these, we have above 20,000 simple sounds that differ either in tone or strength. That this variety does not depend entirely upon the structure, but is the operation of the sense and intellect conjointly, appears from the

long practice required to give that perfection whereof the organ is susceptible.

Nature is bountiful in providing the means both of simple and acquired perception ;—but the latter is the result of long experience and continued effort, though we may have lost the consciousness of its having been originally voluntary.

CHAPTER IV.

ON THE DISEASES OF THE EAR.

HAVING, in the preceding pages, offered a concise description of the structure and function of the ear, we shall now, in prosecution of the chief object of this work, proceed to the consideration of its various diseases, to the accurate knowledge and scientific treatment of which the foregoing inquiry, however interesting in its nature, must undoubtedly be considered subservient. An intimate acquaintance with the structure of an organ, and with the principles of its action, is indeed the only le-

gitimate and sure basis upon which we can erect a successful method of treating its accidental derangements, the probable number and frequency of which will in a great measure depend on the several textures composing it, and on the liability of the organ to be impressed by a diversity of morbid agents or exciting causes.

Reflecting upon the complexity of the ear, and the peculiarity of its function, we cannot be surprised to find that the causes of imperfection or entire loss of the sense are very numerous, and many of them involved in considerable obscurity ; an obscurity not a little increased by the few attempts hitherto made to investigate them by persons qualified, from professional knowledge and experience, to undertake so difficult a subject.

The disorders of other and far less important organs of the human body have been scrutinized with a perseverance and

intelligence that reflect honour upon our age; but the pathology of the ear is, comparatively speaking, still in its infancy. While the sister organ, the eye, has successfully arrested the attention of the most celebrated members of the faculty, the ear has been regarded as almost unworthy the serious notice of regular practitioners, and has become in consequence the favourite object of ignorant and interested empirics, to whose inert or dangerous mismanagement it has been quietly consigned.

This neglect may be referred to several causes, the principal of which are the following :—

First;—the frequent unsatisfactory result of the treatment of the majority of its diseases—doubtless depending, in a degree, on the incurable nature of some of them, but in many instances on the ignorance displayed relative to their real character.

Secondly;—the difficulty attending every attempt to ascertain the more deep-seated morbid affections, in consequence of the interior parts of the auditory apparatus being inaccessible alike to examination and to manual operations.

Thirdly, and lastly ;—The circumstance of the diseases themselves scarcely ever proving fatal, which precludes accurate examination after death ;—and seldom producing *pain*, the great monitor of disease, during their existence.

But surely, the inestimable importance of the function of the ear to our comfort and happiness, being universally admitted, should serve as a stimulus to excite us to further researches in a field hitherto so little cultivated.

A notion—equally pernicious and unfounded—is nevertheless too prevalent, that the diseases of this organ are *generally* incurable, and should therefore be submitted

to with hopeless patience. So long indeed as prejudice and apathy are allowed to usurp the place of medical science, but little hope of improvement in the management of this highly important class of maladies can be entertained.

But if, on the contrary, the same ardent desire were evinced to combat the derangements of the aural function, as we every day see beneficially directed to develop the phenomena and cure the defective or perverted action of other organs, corresponding success might reasonably be anticipated.

This inference may be deduced, indeed, from the improvements which *have been* made of late years by a few individuals—the foremost of whom was the late Mr. Saunders, who first opened the right path in this investigation, and under whose able tuition the author received the rudiments of his practical acquaintance with ophthalmia

and aural surgery. Nor is it to be doubted that many of those diseases which are at present regarded as the opprobria of our art, will ultimately yield to the united labours and persevering exertions of well-educated practitioners.

I am justified in this belief by the consideration that, although we must frequently be content to form a doubtful opinion as to the real cause and nature of the morbid derangements of the labyrinth, and to acknowledge that some of them (as is the case with all diseases of structure) are irremediable ;—yet one particular species, that usually termed *nervous deafness*, admits in some instances of a radical cure, by means to which I shall more fully advert in a subsequent part of this work.

If *some* of the numerous complaints of the ear are confessedly obscure, and, from the nature of the exciting causes, must necessarily resist every method that can be

adopted with a view to their relief, is it consistent with sound philosophy, therefore to infer that we should cease from endeavouring to remedy *any* of them? Such a deduction, if applied to the complaints of vital organs, would, by paralysing all our efforts, be productive of the most obvious and extensive mischief.

We ought rather to regard the ground still untraversed as a sort of *terra incognita*, which the progress of science must sooner or later explore; and become animated in the pursuit by reflecting that, of those ailments incidental to the more complicated structure of the organ of hearing, all are not equally unmanageable; and that many of those which occur in situations open to our inspection, are really very trivial—admitting, when judiciously treated, of complete removal, although, if neglected or mismanaged, they may prove not less destructive to the economy of the auditory

function, than disorders apparently much more serious.

In conclusion, I would repeat that, by acquiring a correct knowledge of the principles on which the operations of this wonderful organ depend, we shall be better able to ascertain in what manner its function may be impaired, and how its disorders may be most effectually relieved. The want of such scientific views has given origin to a popular belief, that the disorders of the ear constitute a class alike intricate and intractable, and requiring a method of cure totally different from those deemed proper for all other maladies.

But while the regular practitioners of the Æsculapian art lent themselves, by their supineness, to these unfounded notions, the ignorant and conceited, taking advantage thereof, boldly usurped their province, and in imitation of the celebrated Dr. Ratcliffe *

* "Cum juvenis eram (inquirebat sagacissimus et ex-

(who, at the commencement of his medical career, fancied himself possessed of at least twenty remedies for every disease) hesitate not to offer their numerous *infallible specifics* for the multifarious derangements of the aural function.

In illustration of the above, I beg to state the following authentic anecdote:—

A person of high rank called some time since to consult me on account of deafness ; but accompanied the statement of his case by observing, that it was quite indifferent whether I could afford relief or not ; “ for,” added he, good-humouredly, putting at the same time his hand into his waistcoat pocket, “ I have here *a dozen certain reme-*

perientissimus senex Ratcliffe,) et in arte medicâ adhuc rudis, adversus unumquemque morbum viginti ad minimum remedia possidebam ; nunc vero, postquam in usu medicinæ consenescerim, viginti et amplius morbos novi, quorum ne unum equidem remedium habeo.”

Gregory's Conspect. Medicin. theoret. vol. i. p. 69.

dies volunteered by my noble female friends." The fact was, that having mentioned the existence of his complaint to as many ladies, they had severally assured him that, by adopting the means each ventured to prescribe, he might make himself *quite sure* of a complete restoration! Thus, as (according to Sterne) all persons pique themselves upon knowing how to mend a bad fire, so there is scarcely an individual, however ignorant, but assumes the knowledge and privilege of dispensing a traditional or domestic panacea for any species of deafness!

The various deviations from the healthy standard which tend to impair or wholly to destroy the function of the ear, are all included under the generic term DEAFNESS, —which, however, is, in strictness of language, only a *symptom*.

In submitting an account of the symptoms and modes of treating the different morbid

affections of the auditory apparatus, it is not my intention, in the present instance, to put forth an elaborate work. My aim is simply to describe them in such plain and familiar language, as will enable those who are not supposed to be conversant with medical topics to recognise their distinctive features, and to adopt the safest and most effectual means of relief.

Persuaded, as I am, that if "a little learning is a dangerous thing" in reference to subjects of literature, it is tenfold more so when applied to the healing art, I shall studiously avoid the error into which writers on popular medicine are too frequently betrayed; namely, that of detailing histories which cannot be understood, and of prescribing formulæ for powerful remedies which cannot be used with impunity by unprofessional readers. Instead of adopting a plan calculated to mislead or injure rather than benefit those who seek to be in-

structed, by arming them with a two-edged sword, which they cannot wield without hazard of wounding themselves, I propose to detail the symptoms which indicate danger, or require for their treatment the hand of experience ;—to point out the various and often unsuspected causes of local derangement ;—to show how far the patient may, without risk, be guided by his own acquired knowledge ;—and lastly, to caution him against the employment of useless or dangerous domestic nostrums, suggested by persons alike ignorant of the nature and character of disease, and of the action and effects of those *remedies* which they so fearlessly recommend.

For the sake of perspicuity, it will be useful, in treating of the several diseases of the ear, to arrange them according to the particular parts of the organ in which they are seated.

With this view, and following the order

of my introductory anatomical description, I shall first examine those ailments (the most simple and least important of the whole) which assail the external part of the auditory apparatus, viz. the auricle and outward passage (meatus auditorius externus;) next, those which attack the middle cavity, or drum (tympanum); and lastly, those of the third division, or labyrinth—embracing what are usually called the nervous affections of the ear.

SECT. I.—*Diseases of the external Ear.*

The auricle, consisting principally, as was shown (p. 18) of a cartilaginous basis with a cutaneous investment or tense skin, is disposed to and participates in the affections incident to such structures. But, by virtue of its elasticity, on the one hand, enabling it to recoil from the effects of pressure or collision, and its low degree of sensibility on the other,—the auricle is a

part little subject to morbid derangements. And although it would appear to serve as a powerful auxiliary to the sense of hearing, it is remarkable, as Itard observes, that wounds which may divide, tumefactions which may deform, and ulcers which may partially destroy its texture, do not sensibly impair its function.* Even its total removal produces for awhile only, according to the authority of Richerand,† a confused and imperfect hearing.

When the auricle happens to be accidentally removed by the sabre, or purposely, as a barbarous punishment for crime, (which formerly obtained in this

* “ Quoique le pavillon paraisse destiné à concourir à l'audition, les plaies qui peuvent le diviser, les engorgements qui se déforment, les ulcères qui le détruisent en partie, ne nuisent point aux fonctions de l'organe.”—Itard, *Traité des Maladies de l'Oreille*, tom. i. p. 324.

† Richerand, *Nosograph. Chirurg.* tom. ii. p. 122. Ed. 2.

abscess should be opened as soon as formed, and the matter discharged; for if it be long retained, it becomes acrimonious, and burrowing between the integuments and the cartilage, produces a troublesome sinuous ulcer, which, when it affects the perichondrium, can only be cured after a tedious process by caustic and escharotic remedies.

In some infants, the secretion of the sebaceous follicles behind the ear is unusually abundant, and if suffered to accumulate, is soon rendered, by its retention and the heat of the part, acrid and offensive—and, excoriating the delicate skin, sometimes occasions deep ulcerations, accompanied with great pain and irritation, and copious purulent mixed with ichorous discharge. The convex or posterior surface of the auricle has been known, under such circumstances, to form a permanent union with the opposite surface, thus causing part

of the auricle to become fixed to the temporal bone. So injurious an occurrence can only arise from the most culpable neglect and inattention to cleanliness on the part of the nurse ; for it may be easily prevented by frequent ablution with warm water, (without any fear of the alarming consequences which Duverney apprehends may result from the sudden suppression of the discharge ;) and then dusting the part affected, if only inflamed or slightly exco-riated, with some absorbent, as starch, or hair-powder, or finely levigated lapis cala-minaris. White lead is occasionally used among the lower classes for the same purpose ; but preparations of that mineral as a domestic remedy are highly objectionable, on account of its becoming in some instances absorbed, and thus producing dele-terious effects.

In the event of the part being ulcerated, — after clearing away the matter, and

touching the denuded surface with a weak solution of the argenti nitratum, to promote cicatrization, a pledget of lint, spread with some mild ointment, should be applied night and morning in contact with the wound, and interposed between the auricle and the temporal bone.

Like other cutaneous surfaces, the auricle is sometimes affected with erysipelas, which disorder it generally undergoes in common with the face or scalp when either of those parts is the seat of this species of inflammation. But as the aural appendage is scarcely ever primarily and exclusively attacked, it does not demand any specific mode of treatment — the same remedies which are proper for the affection of the contiguous surfaces being equally so for that of the external ear.

But the most troublesome and distressing ailment to which the auricle is liable, is an herpetic eruption, consisting of nu-

merous small watery pimples, or vesicles, surrounded by an inflamed base. These little vesicles bursting spontaneously, or being more frequently ruptured by the fingers of the patient—who is almost irresistibly impelled to rub or scratch them, with a view to allay the accompanying almost intolerable smarting and itching—they pour out a copious discharge, which soon becoming foetid and acrimonious, occasions irritation, excoriation, and often ulceration of the affected surface.

If the progress of this disease be not speedily arrested, the skin and subjacent cellular texture begin to thicken and enlarge to such a degree, as to render the auricle, already inflamed, disgustingly frightful and deformed. Nor is this the termination of the mischief.—In consequence of the tumefaction extending to the soft parts of the auditory canal, and of the inspissation of the discharge, the area of this tube be-

comes so much narrowed, and in some instances so completely obliterated, as to offer a considerable barrier or total obstruction to the ingress of sound, causing, while the disorder continues, either partial or total deafness.

Some time since, I was consulted by the daughter of a nobleman, who had suffered for eighteen years from the protracted obstinacy of this disease. By constitutional as well as local remedies, adapted to the nature and urgency of the symptoms, they gradually subsided; the auricle regained its healthy appearance and proper size; and the function of the ear, which had been so long suspended, was at the same time completely restored.

Another lady of high rank requested my opinion and advice respecting an extremely malignant form of this disease, under which she likewise had suffered for a very considerable period. The auricle was in this

instance more than double its natural size, and exhibited the appearance of raw flesh—the surface being exceedingly inflamed and ulcerated. By the extension of the swelling to the external aperture of the ear, added to the accumulation of vitiated secretion, so complete a closure of the opening had taken place that her ladyship was wholly deprived of the use of the organ, besides being tormented by the most distressing irritation and itching.—By means of appropriate general and local remedies the disease was ultimately subdued, and the hearing restored to its former perfect state.

But the worst case of this description that ever came under my notice, or probably under the observation of any other practitioner, was that of a respectable widow lady, past the meridian of life, of a sanguineous temperament—the effect of too luxuriant a mode of living, and of what is called a scorbutic habit of body.

The auricle had acquired an extraor-

dinary bulk, was very red and excoriated, and a most offensive discharge was constantly exuding and partially concreting on its surface,—presenting altogether an aspect of the part scarcely human! I could not have imagined that an enlarged and morbid state of the external ear could have occasioned so great a deformity in the whole physiognomy as was exhibited in the subject of this case. So revolting, in fact, was her appearance, that she found it imperative to withdraw herself, like lepers of old; not only from general society, but even from the observation of her most intimate friends.

Thus excluded from social intercourse, and suffering perpetual irritation both mentally and bodily, her health began to fail, she became subject to the most depressing emotions, and actually desired a speedy termination to her wretched existence.

It was under these gloomy circumstances I was requested to undertake the treat-

ment of this very formidable disease. Notwithstanding the inveteracy of the symptoms, the favourable result which had distinguished my management of similar, though it must be admitted, far less malignant forms of the complaint, encouraged in me the hope of eventual success, by the patient's rigid adherence to a plan which I proposed ; and this hope, I am happy to say, was fulfilled.

Alterative and constitutional, combined with topical remedies were employed ; and by their use the auricle was ultimately reduced to its proper size and healthful character ; the patient's hearing was regained in the utmost degree of perfection ; and her general health and spirits were permanently restored.

In instances of the above description, it is evident that the system at large participates with the local disease, and consequently, both general and local treatment

is indicated; and whilst the constitutional disorder must be corrected; the part peculiarly affected likewise demands the most careful and appropriate management.

The adaptation, however, of remedies to the nature and stage of the local disease, on the one hand, and to the general habit of the patient, on the other, is much too difficult and complicated to be confided to any but the most experienced persons; and indeed varies so exceedingly in different cases, that it would be impossible to lay down other than general rules, the application whereof to particular instances must be entirely governed by existing circumstances, with which the judgment of the practitioner knows how to deal.

SECT. II.—*Diseases of the outer passage of the Ear.*

The diseases which attack the outer passage of the auditory apparatus, reveal-

ing themselves on examination by inspection and the probe, are for the most part among the number of those which are best understood, and admit, when properly managed, of effectual relief.

But before any practitioner ventures to undertake the treatment of this class of aural affections, he should make himself intimately acquainted with the natural structure and appearance of the auditory tube, and with such a position of the head and auricle as will enable him, in a favourable and vivid light, accurately to see (when free from obstruction) every part of the passage, and even the state of the drum of the ear. Without such preliminary means of information, the most serious mischief may result from attempts, apparently obvious, to relieve the various derangements of this outer canal of the ear. Even syringing, generally esteemed as simple as it is supposed to be uniformly successful, is an

operation by no means either safe or easy. It has fallen to my lot to witness in many instances the most disastrous effects from the improper employment of a syringe in reference to auricular complaints, as will be shown in a subsequent part of this work.

The auditory passage, which is curiously tunnelled, and artfully formed to give the undulations of sound an easy admission and gentle refraction, is always open; for even “ whilst asleep,” Cicero remarks, “ we stand in need of the sense of hearing.” But on this very account, it is exposed to the injurious effects of sundry obnoxious agents and atmospheric changes.

The lining of this external tube being a secreting surface, when deprived, from any cause, of its natural lubricating protection, the ear-wax,—is liable, owing to the delicacy of its structure, and the presence of numerous glands, to suffer from sudden

alterations and changes of the air from a high to a low temperature—agents which not unfrequently produce serious mischief in the form of local inflammation.

It is true that “habit is second nature,” and that causes which would, under ordinary circumstances, produce powerful effects, lose much of their malignant influence when applied to parts which have been long accustomed to their impression. Thus, the external ear is rendered, by constant exposure, far less susceptible to the injurious operation of heat and cold, which, if only occasionally applied, would excite the greatest inconvenience and irritation. To illustrate this doctrine, we may adduce the example of the mendicant boy, who, almost in a state of nudity, was running before the carriage of Louis the XIVth, during an intensely cold day, apparently unconscious of the inclemency of the weather. To the humane inquiry of

His Most Christian Majesty, whether he did not suffer extremely from this exposure to the biting frost, the urchin cheerfully and archly replied, "No, and please your gracious Majesty, for I am *all face*!"

However, as such corporeal insensibility is by no means the general attribute of mankind, I shall proceed to point out several unnoticed and unsuspected causes of aural affection. The first I shall advert to is the usual mode of cutting the hair—an unnatural and pernicious mode, the frequent source of various auricular derangements. But though "more honoured in the breach than the observance," yet

" New customs

Though they be never so ridiculous,

Nay, let 'em be *injurious*, yet are followed."

Shakspeare's King Henry VIII.

In venturing to invade the territories of that uncompromising and all-subduing po-

tentate—Fashion, I feel that I shall expose myself to the ridicule or animadversion of its numerous and zealous votaries. I cannot, however, shrink from what I feel to be my duty; and will warn the unsuspecting of latent danger, even at the risk of giving umbrage, and exciting prejudice against my honest exertions and admonitions.

I allude to the bad taste now prevailing, in consequence of which our hair-dressers strip us of the pendent *side-locks*—the real ornaments and guardians of the ear. Nature, unsophisticated nature, by which I mean the Creative Power, does nothing in vain. Is there no *utility*, to say nothing of *beauty*, arising from the partial concealment of the auricle by unrestrained tresses waving from the temples, and hanging gracefully by the side of the face? Such a distribution of the hair not only protects the ear from the intrusion of winged insects and

light substances which move in the liquid firmament, but likewise, by breaking the force of cold winds, guards the organ from the dangerous influence of atmospheric changes.

That such is the natural office and effect of the hair, through the interstices of which the undulations of sound readily penetrate and gain admission into the auditory passage, may be inferred from the well-known analogous fact of a thin net veil affording a salutary shelter or guard against the rude assaults of the wintry blast.

The removal of the side-locks, by exposing the ear to the partial application of cold air, becomes a fruitful source of deafness, originally induced by inflammation of the passage, and consequent suspended secretion of wax. Accordingly, the hair-dressers even warn the profession on this point: one of the most respectable of them informs me, that since this fashion has been

in vogue, many of his customers complain to him of pains in the ear, and increasing difficulty in the function of hearing—doubtless attributable to what may be justly termed a mutilation of the elegant shelter ordained by nature for this important organ.*

In connection with this part of the subject, I cannot avoid adverting to another very general but, I am persuaded, very injurious practice, that of wearing night-caps made of flannel, thick cotton, or dense silk. During our hours of nocturnal rest, the body is very properly placed in an unrestrained recumbent position, and covered, in cold weather, with a great quantity of bed-clothes. Thus situated, the blood flows with increased facility and momentum to

* In a similar manner, custom has dictated the cutting away the hair which naturally lines the auricle in horses, to the great annoyance and sometimes the serious injury of the animal.

the head and superior extremities, to which it is additionally invited, from the heat accumulated by the downy pillows on which we recline, and still further from the wrappers in which the head is usually enveloped.

The evening febrile excitement which late dinners, consisting of stimulant food and beverage, added to mental and bodily exertion in the course of the day, have produced, ought to subside spontaneously, by a moderate, insensible, or gently diffused perspiration during our first tranquil sleep. But this partial accumulation of heat frequently induces, about midnight, profuse secretion from the cutaneous vessels, and great disquietude and restlessness. In this state, we are sometimes apt, instinctively and unconsciously, to divest ourselves of the envelope of the head. Hence, we become exposed to the injurious effects consequent on the sudden transition from

excessive heat to the local application of cold air, which by constringing the exhalent pores of the skin, and suddenly repressing their further serous effusion, causes a congestion of the blood to take place, which, distending the vascular texture of the scalp, occasions that oppressive weight and morning headache so often complained of, and from which many of my patients and friends have been released by abandoning *altogether*, on my recommendation, the use of night-caps.

Females, it must be confessed, are far less liable to suffer from this cause than our sex, on account of their heads being covered after rising from bed with an abundance of hair, or with some kind of ornamental head-dress;—whereas, after sustaining, perhaps for some hours, a greatly increased cutaneous perspiration, we are in the habit of quitting our sleeping apartments, and exposing the head without any adventitious



covering, even in winter, to currents of cold air from corridors, passages, or sitting-rooms,—the inevitably injurious effects whereof upon the unprotected auditory tube may be readily comprehended.

It is to this overlooked but pregnant cause of partial or total deafness, that children and young people so often become subject to ear-ache (otitis), or, in other words, to inflammation of the cutaneous lining of the external passage of the auditory apparatus;—terminating, when neglected or improperly treated, in abscesses, purulent discharge, fungus, and other diseases of this organ.

Another prolific source of auricular derangement, (materially promoted by the injudicious removal of the side-locks,) is connected with the practice so common in all large cities—particularly in the winter-time—of people frequenting evening parties, where they remain for hours pent up

in rooms, the heat of which is raised to a high degree by fires, tapers, and crowds of visitors. Not seldom, on these occasions, the amusement of dancing is superadded, and pursued with unabated zeal and activity, and with little intermission, for successive hours. In this state of corporeal excitement, dressed in a light and elegant costume ill calculated to afford protection against atmospheric changes, the votaries of pleasure, oppressed with heat and exhausted by violent exercise, thoughtlessly seek rest and cool air in the vicinity perhaps of an open window or door,—thus exposing their persons, and particularly the unguarded ears, to the partial application of currents of a much reduced temperature.

The effect of such acts of imprudence is too often a serious, occasionally a *fatal*, inflammation of some vital organ. A less dangerous, though sufficiently pernicious, con-

sequence is, that by the partial application of a stream of cold air, the highly excited and delicate lining of the auditory passage is rendered torpid; secretion is suspended; the vessels become surcharged, from inability to unload themselves; and a reaction, in this state of accumulated sensorial power, takes place on return to a highly heated medium. An inflammatory process being set up, the excretory ducts of the ceruminous glands become contracted, their contents are retained, and a greater or less tumefaction and dryness of the investing membrane is induced.

In this condition of the parts affected, the first and earliest symptom, which ought to excite immediate attention, is a sense of heat and itching, with occasional transitory darting pains, implying a commencing inflammatory excitement in the membranous lining of the passage, inferior only in degree to that which constitutes acute inflam-

mation,—in which, if it be not speedily arrested by art, or do not subside spontaneously, it will most probably terminate.

When actual inflammation of this external passage is produced by these or similar accidental causes, it is characterized by pungent pain in the ear, frequently extending to the side of the head and neighbouring parts ; and by great heat and tension, accompanied, in violent and aggravated cases, with vehement and excruciating agony and high fever :—but, like tooth-ache, it rarely occasions delirium from the brain sympathising with it.

It being the nature and character of inflammation to cause a determination of blood to the vessels, and consequently to increase the bulk of the part it attacks, all the above symptoms are necessary effects of the inflammation of a tense and highly vascular membrane, which is incapable of yielding to pressure on account of its close

connection with the surrounding hard parts.

At the beginning of this complaint, the natural secretion being suppressed, the passage is usually found very hot and dry, as may be perceived by introducing the finger into the ear ; but if resolution take place, which should be promoted by the most active antiphlogistic system, the part becomes moist—an event to be hailed as most fortunate, since it indicates the speedy extinction of the pain and disease.

The above is a concise but accurate description of what is called “external inflammation of the ear” (*otitis externa*), occasionally produced by the extension of some cutaneous affection to its membranous lining, and not unfrequently by small pox, as well as by external violence and rude attempts to extract solid substances which have been impelled or otherwise obtained admission into the passage.

This *external* inflammation of the ear is far less formidable than the *internal*, and may be distinguished by the heat and dryness of the auditory passage, and the early period at which either moisture or discharge presents itself.

By frequent repetitions of this disease, (and every renewed attack increases the tendency to a recurrence,) the inflammation is liable to extend to and implicate that portion of the cutaneous lining which is reflected over the membrane of the drum of the ear, (described page 28) and which it gradually renders thick, dry, and opaque—appearances distinctly visible by inspection in a strong bright light. In this state of the affected part, a sense of cracking (*crepitus*) is sometimes experienced, accompanied with defective hearing—symptoms generally, but I suspect improperly, attributed to a want of wax, a privation which should be considered as operating

secondarily, and injurious only by depriving the passage of its protecting secretion.

I cannot too much reprobate the common custom of having recourse, in these cases, to irritating applications ; the intermittent character of aural inflammation leading the ignorant and inexperienced to suppose, in unconscious compliance with the Hippocratic maxim, “*contraria contrariis curantur*,” that because the disease may be traced, in a majority of instances, to undue exposure to cold, it may be most successfully combated by warmth and stimulants. On the contrary, its cure should be undertaken on the same general principles which serve to regulate our treatment of inflammation in other parts of the body. The first and chief object to be aimed at is, to bring about resolution, which will be best accomplished by reducing arterial action by means of cupping behind

the auricle, or the local application of from two to six leeches behind,* or on the concave surface of the ear,—fumigating the passage with the vapour of poppy-head tea, with a little hot vinegar infused therein, and afterward applying to the opening of the meatus a dossil of lint imbued with warm salad oil.. If the pain does not speedily subside, the bleeding may be repeated, in a quantity proportioned to the urgency of the symptoms. In case the general circulation be accelerated, and the pulse hard, venesection from the arm will be found a useful preliminary before having recourse to topical depletion; and a calomel pill, succeeded by an active purgative, will tend

* In the case of the son of an eminent physician, a leech having been applied in front of the auricle for acute external inflammation of the ear, the temporal artery was penetrated, and required to be divided and tied, to suppress the dangerous hemorrhage that ensued.

more expeditiously to reduce local excitement, and prevent mischief. After the more violent symptoms have, by these means, and by the use of a spare diet, been subdued, a blister may be advantageously applied behind the ear or between the shoulders, which, on the principle of counter-irritation, will do much toward the reduction of the remaining inflammatory excitement. A cooling lotion should at the same time be kept constantly to the part affected, and the head and ear be preserved in a moderate temperature, and raised high in bed, instead of being incased, according to the prevailing practice in these cases, in folds of flannel. By the early and combined agency of such constitutional and topical remedies, instead of spirituous, balsamic, and highly irritating local applications, the symptoms of inflammation may generally be subdued, the integrity of the ear and the perfection of its function

preserved, and long and acute suffering, with the probable ultimate destruction of the organ, avoided.

The above is a mode of treating inflammation of the auditory passage which may be resorted to without fear or risk, and with every probability of effecting a cure. But it sometimes happens that the inflammatory process has gone too far, or is so rapid as to render our best efforts to arrest it unavailing; in which case the inevitable consequences are, suppuration and the formation of an abscess; the latter manifested in some part of the tube in the form of a boil (phlegmon), which, by obstructing the passage, occasions temporary deafness.

When this secondary stage has arrived, suppuration should be promoted by substituting, in lieu of the former plan, warm fomentations, and poultices, and a generous diet. The matter, allowed to take its

own course, either escapes between the auricle and mastoid process, or gains admission, by means of a small aperture, into the outer passage of the ear, in which event spongy granulations not unfrequently protrude through the contracted aperture in form of polypi, and occasionally plugging up the orifice, cause returns of pain, and keep up continual annoyance by the accumulation and retention of the purulent matter.

The early evacuation of the discharge is of the greatest importance; for if suffered to remain in contact with the denuded bone, caries will be produced, and in that case the cure can only be effected by subsequent exfoliation or separation of the dead portion.

I have seen more than one instance in which, apparently, the whole osseous part of the tube has thus died and become detached. A case of this description was

brought for my advice some years ago from Dublin, wherein the part healed, and the function of the ear was restored.

SECT. III.—*Of fungous Excrescences of the Ear.*

The lining of the auditory passage, like that of the nose (schneiderian or mucous membrane), and, I may add, all other secreting surfaces, is sometimes disposed to produce excrescences, generally termed polypi, but which more nearly resemble syphilitic warts, and appear to be the offspring of irritation.

These may be extracted by the forceps; or, if they are attached by a small pedicle, removed by means of the scissors or a ligature, and the part from which they are torn or cut should be immediately after touched with the lunar caustic (argentum nitratum), care being taken during its application to avoid injuring the membrane of the drum,

and the sound part of the lining of the tube.

It is particularly necessary to distinguish these cuticular excrescences from the fungous growth which springs from the denuded bone, as we shall hereafter describe, of the cavity of the tympanum.

SECT. IV.—*Morbid Septum of the Auditory Passage.*

An adventitious membranous septum is sometimes found in the inside of the auditory tube, before the membrane of the drum, which, by closing up the passage and excluding the admission of sonorous undulations, necessarily occasions complete deafness, unaccompanied however by any false perceptions of sound, (*tinnitus aurium*.)

This artificial septum may be a congenital malformation; but I have met with a few instances of its occurrence in inveterate cases of purulent discharge. It may,

in fact, be suspected to be the cause of total loss of hearing, when the patient, having laboured for some time under a puriform discharge (otorrhœa,) is no longer capable of forcing air as usual through the external passage. The existence of this newly formed septum may be satisfactorily ascertained by inspecting the passage in a strong light.

In the course of my experience, I have had several opportunities of witnessing this disease. A gentleman some time ago brought his son to consult me respecting the total loss of his hearing. Upon carefully inspecting the meatus, I discovered, what I had from the symptoms anticipated, a distinctly formed membranous septum, nearly transparent, and without any apparent vascular ramifications. Although it was placed not more, I conceive, than about a quarter of an inch from the membrane of

the drum, I found no difficulty in puncturing and lacerating it, when the sense of hearing was instantaneously restored to a degree of acuteness that for a time really distressed the patient. Fabricius and Veslingius, as well as Duverney and Maunoir, have published cases of deafness arising from this source. The obvious mode of treatment consists in what has been just described,—namely, in freely breaking up this membranous partition, which, being without nerves, is wholly destitute of sensation. Should the disease be either congenital, or occur at a subsequent period of life, if the rest of the auditory apparatus be healthy, the patient becomes *immediately* capable of hearing the lowest sounds, and the cure is completed. But in case of this mechanical impediment being the result of concrete matter from preceding purulent discharge, the function of the organ will be

regained, on its removal, only in that degree in which it subsisted before the formation of the artificial septum.

SECT. V.—*Extraneous substances, or Insects, in the outer passage of the Ear.*

From what has been advanced in the last section, it is evident that the function of the ear cannot be adequately performed, unless the external passage be free and unembarrassed. But in consequence of its exposed situation and naturally pervious state, it is liable to occasional accidents, to the introduction of foreign bodies, and the intrusion of living insects.

Children, being prone to imitation, are sometimes prompted, from seeing adults put cotton or wool into their ears, unconscious of danger, to introduce into the auditory tube of their little companions, peas, small fruit-stones, beads, pebbles, or any other more or less solid extraneous sub-

stances they may happen at the time to possess,—which occasionally leads to serious mischief by irritation, pressure, or laceration of the soft parts of the tube.

A remarkable instance of the terrible propulsion of a foreign substance into the ear, occurred to an officer of high rank and distinguished courage during the Peninsular War. Having been wounded in one of the numerous engagements wherein he had taken an active part, he became exceedingly weakened from loss of blood, pain, and confinement.

Being at length sufficiently recovered to rise from bed, he was recommended exercise, for the purpose of recruiting his enfeebled health. Accordingly, he mounted a spirited mule, which, from feeling but little restraint, started off with him, and in its rapid course homeward, galloped under an oak-tree. The pendent branches coming suddenly and forcibly in contact with the

side of the rider's head and face, inflicted a severe lacerated wound of the auricle, inducing the usual concourse of symptoms indicative of external inflammation of the ear (*otitis externa*), the violence of which subsided on the appearance of a copious purulent discharge. In spite of the various applications resorted to with a view to suppress the disease, matter continued to issue from the outer passage in considerable quantity.

Returning to England in this state, and with the sense of hearing nearly extinguished, he called to consult me on the subject. Upon attentively inspecting the tube, in a clear light, I noticed something lying at the very bottom of the passage, which, on cautiously pressing upon it with a probe, proved to be hard and resisting, but at the same time slightly moveable.

On considering the concussion he had sustained, in connection with all the other

circumstances of the case, I was led to suspect that a portion of the bony meatus, being fractured, had become detached, and by its presence served to keep up the discharge.

I proposed, at all events, whatever might be its nature, to extract this body—an operation which with some difficulty was accomplished. On examining the extraneous substance, after freeing it from all adhesive matter, I found that it was a splinter of oak, the introduction of which could easily be explained, nearly half an inch in length, and about two lines in breadth,—one pointed extremity whereof had penetrated through the membrane of the drum, whilst the remainder lay fixed across the passage in the angle formed at its farther extremity.

This foreign substance having been removed, the ulcer which it produced and kept in a perpetual state of irritation, speedily healed, and the hearing was perfectly restored.

A hard foreign body being impacted in the auditory passage, especially in its bony portion, is liable to excite the most excruciating pain, and if not soon removed, may induce even alarming symptoms.

Fabricius Hildanus * details a case of a young girl who accidentally let a glass ball drop into her left ear. Intense pain and inflammation supervened, and were succeeded by a train of the most formidable symptoms, which continued during the space of eight years, when they at length subsided on the removal of the exciting cause. The same author, as well as Schenckius, gives instances of seeds and grains swelling and actually *germinating* by their retention in the heat and moisture of the auditory passage.

Whilst it is necessary that these impacted substances should be removed with all pos-

* Hildanus, Observat. 4. art. 4.



own course, either escapes between the auricle and mastoid process, or gains admission, by means of a small aperture, into the outer passage of the ear, in which event spongy granulations not unfrequently protrude through the contracted aperture in form of polypi, and occasionally plugging up the orifice, cause returns of pain, and keep up continual annoyance by the accumulation and retention of the purulent matter.

The early evacuation of the discharge is of the greatest importance ; for if suffered to remain in contact with the denuded bone, caries will be produced, and in that case the cure can only be effected by subsequent exfoliation or separation of the dead portion.

I have seen more than one instance in which, apparently, the whole osseous part of the tube has thus died and become detached. A case of this description was

brought for my advice some years ago from Dublin, wherein the part healed, and the function of the ear was restored.

SECT. III.—*Of fungous Excrescences of the Ear.*

The lining of the auditory passage, like that of the nose (schneiderian or mucous membrane), and, I may add, all other secreting surfaces, is sometimes disposed to produce excrescences, generally termed polypi, but which more nearly resemble syphilitic warts, and appear to be the offspring of irritation.

These may be extracted by the forceps; or, if they are attached by a small pedicle, removed by means of the scissors or a ligature, and the part from which they are torn or cut should be immediately after touched with the lunar caustic (argentum nitratum), care being taken during its application to avoid injuring the membrane of the drum,

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very interesting cases of this description, and have shown that many extraordinary and anomalous morbid phenomena have originated from living insects existing in the different divisions of the ear. Instances of this sort have not hitherto presented themselves to my observation ; but from the examples given by authors of unquestionable veracity, it will be prudent, in cases characterized by an assemblage of singular and inexplicable symptoms, to bear this fact in mind, and endeavour to ascertain whether such symptoms—especially in children—may not sometimes arise from this unsuspected cause. I have heard it stated, on good authority, that a lady of consequence was relieved from long-continued and intense headache, and other sympathetic pains and nervous irritation, by the sudden dislodgment of worms from the nose (frontal sinus) by the empirical use of a potent snuff,—the presence of which

worms, as the source of her acute sufferings, not having been previously suspected by her medical attendants.

SECT. VI. — *Redundancy or deficiency of Ear-wax.*

The glands of the ear destined to secrete the cerumen are liable, in common with all other secreting organs of the human body, to be affected by local and constitutional causes, and hence may become either preternaturally torpid or active, and pour out too much or too little of their proper secretion.

It is probable that, if every cause capable of interfering with or disturbing their action could be withheld, the ceruminous glands would supply the just proportion of secretion, and that of a healthful character, and the auditory passage be kept, in consequence, in a sound condition, fit for the performance of its function in the utmost degree of perfection.

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But numerous causes concur to derange this economy, several of which have been already detailed ; and to these may be added the consequences of a very common and injurious practice—namely, the use of *ear-pickers*, made of gold, silver, ivory, or some other hard substance ; the dextrous manipulation of which constitutes a considerable source of emolument among the Chinese and nations of India.

So firmly persuaded was Sir Hans Sloane of the bad effects of these instruments that, in a paper which he wrote on the subject in the *Philosophical Transactions*, he does not hesitate to declare that he could trace to their officious use *nearly all* the cases of deafness which were brought for his assistance.

Again ; many persons are almost unconsciously in the habit of amusing themselves, and beguiling their vacant moments, by applying the end of ~~one~~ of their fingers

to the opening of the ear, which gentle friction produces an agreeable titillation—but at the expense of exciting an undue action in the ceruminous glands, and, consequently, morbidly increased and depraved secretion.

In warm, bilious, and scrofulous constitutions, the glandular secretions are very apt to be affected by apparently trivial causes; and in such habits, atmospheric changes are not unfrequently the source of considerable aberration in regard to the quality and quantity of the product of the ceruminous glands.

The symptoms characteristic of a diminution of hearing proceeding from an imperfect or deficient secretion of wax, are—a dry, rustling sound, like the crackling of a distended bladder when handled, particularly during mastication; and an occasional ringing or depraved noise, with a dull sensation, in the ear. The sense of

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dried parchment, the agitation of which may naturally be supposed to produce a sensation of crackling noise. In every instance, I could trace the origin of the disease to the partial application of cold air, or to bathing at a time when the heat of the body had been raised to a high temperature. A torpor of the vessels of the cutaneous lining of the auditory passage being induced, and a subsequent reaction occurring, a slow chronic inflammation is set up, the tendency whereof is to cause an interruption of secretion and a gradual thickening of the investing membrane, or, in other words, of the portion which is reflected over that of the drum, rendering it less easily susceptible of the pulsations of sound and of ordinary stimuli.*

The mode of treatment which I have

* I have just seen a gentleman with the above assemblage of symptoms induced by cold whilst under the influence of mercury.

found most beneficial in this species of aural disease, consists in paying the greatest attention to the general health—cautioning the patient against exposure to cold, wet, or evening air, and against irregularities in conduct and diet; and in instituting a new and healthy action in the secretory apparatus by a degree of warmth, and medicated local remedies, adapted to the sensibility of the part affected.

A desquamation of the thickened cuticle sometimes occurs, and affords considerable relief, clearly proving the correctness of my ideas as to the nature and cause of this affection.

But the most frequent source of deafness connected with and dependent on the state of the external passage, is a preternatural accumulation and inspissation of the wax.

If, as I have already (p. 165) suggested, the glands which secrete the wax were never hurried or retarded in their action by

morbid influence, either constitutional or local, it seems rational to conclude, that the secretion would be yielded both in point of quality and quantity commensurate with the necessities of the organ.

The wax in its healthy state is little if at all disposed to concrete; and were not the glands irritated by picking or rubbing the ears with the finger or a coarse towel (under an impression of cleanliness), which keeps them in a state of fretful excitement, together with other injurious practices, a morbidly profuse secretion would in all probability very seldom occur. When, from any peculiar circumstance, it might take place, the redundant quantity would be pushed outward by fresh secretion *a tergo*, aided by the propelling power of the lower jaw during the act of speech; and especially of mastication—the operation of which will be easily perceived and understood by introducing at such periods the finger into the meatus.

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consistency of the wax ; for it is the *induration* rather than the *quantity* of it that produces deafness : if *soft*, it does not essentially injure the function of the organ ; whereas a very small portion of concrete wax, lodging upon the membranous septum of the drum, will be sufficient to deprive a person of his hearing.

Bonetus, and the older writers,* entertained the belief that the ear-wax, like the bile, which they fancied it nearly resembled in quality, may be susceptible of petrification. Accordingly, in the 45th Observation of Bartholine's Journal, is a statement of the case of his wife, who is represented to have been a long time tormented with a pain round the ear, which was ultimately alleviated by the discharge of small stones from the auditory passage.

The symptoms which indicate the pre-

* They treat of these cases under the head of "Auditus læsio a sordibus aurium lapidescentibus."

sence of indurated wax, are, a greater or less degree of deafness, combined with a dull heavy sensation of confused sound, and a sense of clashing, or of the ponderous strokes of a large hammer, which prevail mostly during mastication.

Various methods—some of them not a little ridiculous—have been devised for the removal of indurated wax. Perhaps the most efficacious is, to syringe the ear with warm water, which Dr. Haygarth found to be the best solvent of the mucous matter which cements together the bitter ceruminous particles, and which is the cause of the tenacity of the wax. As the deafness proceeding herefrom is purely adventitious, the organ being sound, the removal of the hardened wax instantly restores the sense of hearing, which for a time, in consequence of accumulated sensorial power, becomes, in some instances, distressingly acute.

But the operation of syringing the ear, which is indiscriminately regarded as a specific, and almost invariably resorted to for the cure of every species of deafness, is not, as I have before observed, at all times either safe, or easy of execution. When a stream of water is forcibly and injudiciously projected into the ear, in the absence of any protecting medium, as wax, or accumulated matter, the delicate membrane of the drum is occasionally over-stretched, sometimes even lacerated, and inflammation in consequence superinduced.

In reference to this operation, the tortuous course of the auditory passage ought to be duly considered; otherwise the stream of injected liquid, instead of being made to act upon the extraneous matter meant to be removed, may impinge against the bony protuberance of the meatus, and prove not only unavailing for the purpose intended, but injurious, by the point of the syringe striking against the side of the

tube, and lacerating its membrane, or even bursting the drum of the ear.

Again : when recourse has been had to this process for the removal of hardened wax, if the nozzle of the instrument be incautiously inserted, so as to close the entrance of the tube, the injected liquid, instead of returning in a counter-stream, being impelled with unrestrained momentum, and carrying before it the inspissated wax against the fine membrane of the drum, has caused it to be ruptured, the connected bones in its cavity to be dislocated, and thus the function of the organ to be irretrievably destroyed.

When syringing is adroitly and successfully performed, the patient should feel an *agreeable* rather than a *painful* sensation ; and neither should blood escape, nor any uneasiness supervene—results by no means uncommon, when the attempt is made by unskilful or inexperienced hands.

In short, this operation, although com-

monly held to be the most trivial of any performed upon the human body, requires, in order to be rendered efficient and safe, a thorough mechanical knowledge of the principles and mode of using the ear-syringe; of the occasions on which alone it is proper to be used; and above all, of the structure and direction of the auditory passage, added to the most advantageous method of fixing the head of the patient, and regulating the position of the auricle.

The legitimate object of this operation may be said to consist in the removal from the auditory passage of extraneous substances, indurated wax, or suppurative matter, so as to allow of the free inspection of the parts, and the application of medicated remedies to the swollen, inflamed, abraded, ulcerated, or indurated surface of the tube. It is often necessary simply to enable us to examine in a proper manner the state of the drum of the ear.

To syringe the ear for any other purpose is not only useless, but may prove highly detrimental, and is calculated to bring into discredit an operation which, when rationally adopted and properly performed, is often of signal value and utility.

SECT. VII.—*Congenital Deafness.*

A species of congenital deafness exists, proceeding from a detention of what is technically called the pseudo-membrana,* or membrana mucosa of Duverney, secreted during the fœtal state, and which usually comes away spontaneously and piecemeal after birth, along with the wax.

* Paulus Ægineta makes mention of this membrane, and adds, that it is occasionally the cause of congenital deafness. It seems to be a secretion from the meatus, and to have been first noticed by Fabricius ab Aquapendente. Ruysch, in his *Thesaurus Anatomicus*, states his belief that it consists of the epidermis.

The system of the Divine Creator, in furnishing the several secreting passages with a protecting medium against the injurious effects of the aqueous fluid (liquor amnii) in which the fœtus is always immersed during its confinement *in utero*, is a striking instance of consummate wisdom and goodness; for, without such a guard, the membrane of the drum would have become too much relaxed to be able properly to perform its function. A provision is also by this means made against the sudden impulse of sound, with which the new-born infant might otherwise be painfully affected—the ears not being covered, like the eyes, by any natural mechanism.

The disease which results from this mechanical obstruction, and which is a much more frequent cause of infantile deafness than is generally supposed, has been often imputed to organic defect. With respect

to several children, declared to have been born irremediably deaf and dumb, I have obtained no small share of credit and eclat by removing this substance—the sole cause of the suppressed auditory function ; thus at once giving freedom to the sense of hearing and the faculty of speech !

It often happens, however, that the source of congenital deafness is a much more formidable, and, occasionally, an incurable malformation, or total obliteration of the auditory passage, which is sometimes formed too narrow to admit the free ingress of sonorous undulations ; and, consequently, the hearing is rendered feeble and imperfect. Leschevin* states, that de la Metrie had noticed this canal so narrow in a young subject, as with difficulty to receive a probe.

Should the contraction depend upon

* Prix de l'Academ. de Chirurg. Tom. ix. p. 132.

malconformation of bone, it must necessarily be incurable. Two instances of this kind have lately come under my care—the one, a gentleman from the Sister Island, in whose meatus a considerable exostosis projects from the outer portion, and nearly obstructs the passage; the other, an English nobleman, in whose auditory tube a similar growth of bone is formed, almost obliterating the canal.

If, on the other hand, the tube be obstructed simply by a thickening of its soft parts, means may be applied with the prospect of dilating the passage; and if the organ be in other respects sound, of effecting a complete restoration. I happen to have, at the present moment, no fewer than four patients of this description under my care, two of whom have already regained their long-lost hearing; and the other two (young ladies) are rapidly experiencing so much benefit in point of the enlargement

of the area of the tube, as to leave no doubt whatever of the contraction eventually giving way.

The mode of effecting a cure in these cases, is by means of alterative remedies, counter-irritation, and mechanical dilatation.

SECT. VIII.—*Diseases of the Membrane of the Drum.*

Various authors, and particularly Duverney, make a great parade and display of the diseases of the membrana tympani, which he describes under the pompous titles of nimia relaxatio, tensio nimia, induratio, and disruptio membranæ tympani.

First: The mechanical idea of *relaxation* of the drum has no doubt arisen from the effect of moist weather, fogs, and warm southerly winds, in producing a thickness or dulness of the sense of hearing, the above causes being supposed to act by

communicating too great a degree of humidity, and consequent relaxation of that membrane.

The perfection of the aural function, under ordinary circumstances, and in the healthful condition of the organ, is essentially connected with and influenced by the condition of the membrana tympani. Unless this fine partition possess a proper degree of moisture and pliability, how can it be obedient, on the one hand, to the pulsations of sound, and, on the other, to the action of the tympanic muscles, which, through the medium of the passive and non-resisting ossicles of the cavity of the tympanum, are designed to regulate and modify the vibrations of the drum, (according to the force or weakness of the undulations of sound,) in order that they may be transmitted to, and make the due impression upon, the nerve expanded in the various parts of the labyrinth?

But as that species of deafness which is aggravated in a warm or moist, and ameliorated in a cold bracing atmosphere, is commonly attended with catarrhal symptoms, the defect of hearing in these cases is, perhaps, not so much owing to any alteration in the state of the membrane of the drum expressed by the term *nimia relaxatio*, as to a swelling at the mouth of the Eustachian tube, on the inside of the throat.

The second disease of this membrane, as enumerated above, is said to depend upon its too great *tension*. In this ailment, the patient hears best in a humid state of the air, and after the application of tepid and oleaginous substances—loud noises, in a clear atmosphere, proving painful, nay, almost insupportable.

But these symptoms, constituting the disease designated *tensio nimia*, may be explained in a more satisfactory and rational manner on the supposition that the nerve

itself has acquired a morbid and preternatural susceptibility, in consequence, probably, of an inflammatory state of the sensorial organ—the brain; a condition which bespeaks no small danger, and demands the greatest attention in order to avert worse and even dangerous consequences. The complaint also occasionally results from a high degree of nervous excitability, induced by excessive uterine, or other kinds of hæmorrhage.

Thirdly : With regard to the *indurated* or *schirrous* state of the membrane under consideration, we are convinced that this may, like other membranes, become thickened by inflammation, or by cartilaginous or even bony depositions. In such cases, it cannot vibrate freely, and consequently must of necessity occasion incurable deafness, unless puncturing it should prove an effectual remedy.

I have had numerous opportunities of no-

ticing a *thickened* state of this septum, arising sometimes from an interstitial deposit, rendering this naturally semi-transparent substance exceedingly opaque; and occasionally, from the formation of an adventitious membrane, or *false drum*, as it has been called, (the effect of inflammation of the membrana tympani,) and the consequent effusion and inspissation of coagulable lymph, by the removal of which the patient has entirely regained his hearing.

Fourthly: But though the integrity and healthy condition of this membranous partition of the drum be requisite, in order that the function of the organ may be performed in its highest state of delicacy and perfection, its partial or even total destruction by rupture or ulceration does not *annihilate* the sense of hearing.

Its loss or imperfection is, however, productive of serious inconvenience. The morbid influence of atmospheric changes on the

exposed cavity of the tympanum occasions great fluctuations in the function of the organ, by acting upon its secreting surfaces in a manner similar to that in which the same cause acts upon the mucous or schneiderian membrane of the nostrils. By a desiccation of the discharge, the cavity of the drum becomes plugged up, and deafness ensues, which may be alleviated or removed by dislodging the concrete secretion by means of syringing with due care and address.

I will further add, in reference to the cavity of the drum, that even *three* out of its *four* small bones (ossicles) may be detached and removed without destroying the hearing—the fenestra rotunda, as Scarpa suggests, performing probably, in these cases, the office of the membrane of the drum. But if the fourth bone, the stirrup (stapes), the base of which shuts one of the two openings into the labyrinth, be separated from its

attachment, the patient must inevitably and irrecoverably experience a total extinction of the sense of hearing.

Some years since I was called to attend a young lady at a great distance from the metropolis, on account of complete deafness. Her parents expressed their anxiety for her restoration in the most pathetic terms, showing me at the same time the bones which the cavity of each ear had contained,—the whole bony contents having escaped along with the purulent discharge. Upon finding the two stirrup bones among the number, I had the painful task of being compelled to damp their sanguine hopes, by declaring my conviction of the utter hopelessness of the case, and of the impossibility of affording the smallest relief.

As to the rupture of the membrane of the drum, of which Tulpius gives two instances in his "Observations," (occasioned by violent sneezing at a time when the pa-

tients were labouring under great swelling of the nostrils and throat, the effect of cold); so far is this from being the cause of deafness, that the septum is sometimes punctured, in order to *restore* hearing.

We know, indeed, that a severe shock on the head may occasion a rupture of this membranous partition, accompanied by a bleeding at the nose. Valsalva supposed that the blood, in these cases, proceeded from the ventricles of the brain, through certain holes (foramina) of the bone which he discovered, having in one instance detected coagulated blood both in the labyrinth and middle cavity of the ear.

But the anatomical structure of these parts forbids such an inference—the fact asserted proving only that the concussion was, in that instance, extremely violent, and that what was capable of injuring the mechanism of the ear so much, would exert a proportionably greater effect on the brain.

In truth, the symptoms alluded to indicate a fracture of the base of the skull, which generally terminates fatally ; but, as it is not invariably so, if deafness supervene, it will be right to puncture the membrane of the drum—a practice, the advantage of which is exemplified in a case of this kind related by Sir Astley Cooper,* who by pursuing that method of treatment succeeded in restoring the patient to hearing, blood continuing to discharge itself for ten days through the artificial opening.

If the blood thus extravasated were suffered to remain, it might become organized, and of necessity prevent the free vibration and action of the membrane, and of the bones in the drum of the ear.

In the several affections of the membrane of the drum above enumerated, the nicest discrimination is requisite, in order to avoid serious mistakes, and to be able to apply

* In the Philosophical Transactions.

such remedies as the symptoms of the case may demand. No one, indeed, can be deemed competent to undertake their safe and successful management, but such as are not only thoroughly acquainted with the natural appearance of the membrane of the drum, and its various maladies, but also capable of ascertaining, by actual inspection, the mode of treatment best adapted to each respective form of the disease.

CHAPTER V.

DISEASES OF THE DRUM OF THE EAR.

THE order of our arrangement leads us next to advert to the complaints incident to the middle cavity of the ear, the principal and most important of which class is inflammation, and puriform discharge; a morbid affection which arises from a variety of causes. Of these, the most devastating is the malignant scarlet fever (*scarlatina maligna*); but the most common, acute internal inflammation of the ear (*otitis interna*), generally denominated ear-ache, the frequent consequence

of a partial application of cold air to the organ.

The late Mr. Saunders furnished the earliest and best description of the origin and progress of this malady; a description, indeed, so clear, comprehensive, and satisfactory, that he well merited the praise awarded to him, in consequence, by the profession. As the public and the profession have for some years been in possession of Mr. Saunders's valuable observations on this disorder, I shall introduce into the present work such additional facts and illustrations as my own experience has suggested.

SECT I.—*Puriform discharge from the Tympanum.*

The symptoms which indicate acute inflammation of the drum of the ear, are, a greater or less sense of tensive and throbbing pain of the organ, deep-seated, and

extending to the throat and side of the head, accompanied by symptomatic fever, and not unfrequently, in violent cases, by a degree of delirium. The pain is not at all times equally intense, but intermits occasionally, like the paroxysms of tooth-ache,—a circumstance which has caused it to be mistaken for a spasmodic affection, and in consequence to be too often either entirely neglected, or improperly treated by acrid or spirituous applications; remedies which contribute to hasten suppuration, a result which every judicious means should be sedulously taken to avoid.

If the pain and inflammation do not speedily subside, or are not assuaged by art, the mucous membrane lining the drum and the mastoid cells takes on the suppurative action, and secretes a prodigious quantity of matter, varying greatly in color and consistency. This is soon followed by an ulceration of the membranous septum

of the tympanum, and the pus which had accumulated being suddenly and copiously discharged, the patient is delighted with the unexpected ease instantaneously experienced.

It may seem singular that the matter formed in such large quantities in the central cavity of the ear, should almost uniformly force its way externally, through an opening of the membrane of the drum, into the outer passage of the ear, rather than through the apparently more direct and open course of the Eustachian trumpet into the throat. This circumstance is probably referrible to that tube becoming obstructed and rendered impervious by the temporary swelling of its mucous lining, occasioned by inflammation.

The cavity of the drum thus continues, for an indefinite period, to pour out matter, more or less in quantity, which usually escapes by the auditory passage in a fetid state.

Such is generally the progress of the disease in strong healthy habits; but in scrofulous constitutions, it commences much more insidiously. Instead of being *acute*, the inflammation is then generally of a *chronic* nature, and produces only slight intermittent pains, which are relieved by the discharge of a small quantity of matter. These attacks return at intervals, generally on exposure to cold; and being neglected, the purulent stage is at length fully established.

As the obvious tendency of these two forms of the disease is to destroy the function of the organ by the injury done to the membrane and contents of the drum, the symptoms should be combated on their first appearance, or as soon as possible after they have manifested their real character, by the most active antiphlogistic measures, which, if promptly adopted, will in the majority of instances produce resolution.

It notwithstanding sometimes happens,

in consequence of the thickening of parts by the deposition of coagulable lymph; that the deafness, which is always considerable during the inflammation, instead of subsiding as that abates, still remains. By the agency of mercury, we can effect the absorption of effused lymph, and thus prevent its becoming organized. It is in cases of this description, particularly, that the salutary influence of that potent mineral is experienced, by the exhibition of which hearing is often restored.

Should suppuration actually have commenced, we ought not to delay puncturing the membrane of the drum, in order to evacuate the collected matter, and prevent the septum from acquiring that condition which would incapacitate it from receiving, with due effect, the undulations of sound.

It is a point of no small importance, to ascertain that the matter comes from the cavity of the drum, which may be done by

examination of the meatus in a strong light; or by a blunt probe carefully introduced into the auditory passage, when an experienced practitioner will have no difficulty in judging, by the peculiar sensation communicated to the instrument striking against the bone, whether or not the membrane of the drum be destroyed.

Further and collateral evidence may sometimes be derived from the circumstance of the patient being able to expel air through the ruptured membrane. His not being able to effect this, however, proves only that the same inflammatory action which produced the disease in the cavity of the drum, has also caused a thickening and obstruction of the lining, and consequently an impervious state of the Eustachian tube.

On the supposition, then, that the puriform discharge is fully established, is it prudent or safe to attempt its suppression? Many writers and practitioners, among

whom may be included the late Dr. Heberden, esteeming the discharge as a salutary drain, loudly inveigh against the officious interposition of art,—apprehensive that the matter, by the application of remedies calculated to restrain it, might be diverted from its usual course or outlet, and be translated to the brain!

It cannot be denied that, when the system has been long accustomed to furnish daily a large quantity of pus, the formation and secretion of which we have reason to believe is not effected without considerable expenditure of blood and vital energy, the sudden cessation of the discharge, before nature can adjust her powers thereto, will leave a redundancy of blood in the system. Before this surplus can be disposed of, it may be determined with unwonted impetus to some vital organ, constitutionally and originally weak, and therefore incapable of resisting, and produce congestion and

other dangerous effects. Hence, apoplexy, dropsy, and the various diseases which occasionally supervene on the sudden suppression of habitual discharges; examples of which are too notorious to require particularising.

It is of importance to remark, however, that these results occur only in *inveterate* cases; the immediate stoppage of a discharge, however copious, from a *recent* sore, may be effected without inducing any such serious consequences.

In reference to the subject under discussion, there are several specious cases upon record which, on a superficial view, might lead the inexperienced to doubt the propriety, even the safety, of curing this disease.

Valsalva relates, that one of his patients received an injury of the head, which was relieved so long as the discharge from the ear continued free; but on that being stopped, he died.

Morgagni also gives a case, in which, when the matter from the ear was suppressed, pain and weight of the head came on and resisted every plan that was adopted for their relief. On dissection, an abscess was found within the skull.

Again: Bonetus states an instance in which an ignorant surgeon suppressed the discharge from a fistulous ulcer of the ear, and thereby occasioned the death of the patient.

Duverney likewise adduces the history of a man sixty-five years of age, of a full sanguineous constitution, who suffered under a very considerable suppuration of his ears for twenty-five years, though in other respects he enjoyed the most perfect health. The matter was foetid and thick, and its stoppage proved fatal in twenty-four hours. In this instance, the cranium was opened; and all the parts of the brain, near the petrous portion of the

temporal bone, were carefully examined, and found perfectly sound; but there was a serous effusion in the ventricles of the brain quite different in quality and appearance from the aural discharge. Duverney adds, that he has opened the ears of many children, in which the tympanum was full of filth, yet never saw any bad disposition in the brain or os petrosum.

From the above facts, we are justified, I apprehend, in drawing the inference, that the unfortunate events which have supervened upon the casual suppression of the puriform discharge, are referrible to other causes than to a translation of morbid matter to the brain, which in truth can only be injured by exposure and inflammation, or ulceration of the dura mater—the external investing membrane of that vital organ.

But the puriform discharge has a natural tendency to ulceration, and ulceration to denudation and caries of the bone. Were

it not, indeed, for that salutary law of the machine by which membranes lining cavities thicken as ulceration proceeds in the neighbouring parts, the brain would probably always suffer in the last stage of the puriform discharge from the tympanum.

Persuaded, then, that the puriform discharge is a purely local complaint, and that the danger attending it is referrible to its continuance rather than its removal, we do not hesitate to recommend the discharge to be suppressed.

With this view, a simply astringent injection, used night and morning, will almost invariably be found, by perseverance in its use for an adequate period, equal to the cure of this noisome malady,—provided it be not combined with caries, without the supervention of which we know it may exist in a simple form for many years.

It is not possible to affix the exact date

of its transition from the first to the second stage, as in some instances they exist at nearly the same time, particularly after the malignant scarlet fever; whilst in other cases, the disease will not advance, after a long lapse of years, beyond the simply purulent state.

It is right to notice, that mucous membranes may have their natural secretions increased by irritation or under inflammatory excitement, and may pour out large quantities of purulent matter,—as Mr. Hunter has satisfactorily shown in his valuable Treatise on Inflammation and Gun-shot Wounds,—without any breach of surface, or ulcerative process.

The varied nature and augmented quantity of the discharge from the cavity of the drum, under different degrees of excitement, admit of elucidation from considering the altered character and profuse secre-

tion from serous, mucous, and also of purulent fluid from the schneiderian membrane of the nose, under the influence of catarrh.

Although the liability of the purulent disease being extended to the brain, from its suppression in the ear, is undoubtedly a groundless cause of apprehension, I should notwithstanding, for the reasons previously alleged, urge the propriety, before attempting its removal, of guarding against a sudden plethora and its consequences, by general bleeding, if the patient happen to be of a full habit and sanguineous temperament, restricting him for a time to a spare vegetable diet, and directing him to avoid the use of much liquid. Should the case be one of long standing, the cure will be expedited and contingent danger avoided by a perpetual blister, or, what is preferable, the introduction of an issue, or rather a seton in the nape of the neck, with a view to excite a counter-irritation; thus sub-

stituting a harmless discharge for one that is often attended with alarming symptoms—and not, in accordance with the humoral pathology, in the expectation of gaining any advantage on the mechanical principle of drawing away the diseased humors. If the bowels be inactive, an occasional dose of calomel (hydrarg. submur.), with the employment of an adequate quantity of saline aperient to insure two or three daily evacuations, will contribute to hasten the recovery of the patient.

By such means, assiduously persevered in, I have frequently succeeded in freeing patients from an offensive and very troublesome malady, which had distressed them for many years, without witnessing in a single case the slightest inconvenience.

But the degree of restored hearing which follows the cure, differs according to the extent of injury the disease has produced in the contents of the drum. In general,

however, the function of the ear is *greatly* improved, since the thickening of the parts, and the collection of matter, have a manifest influence in impeding the action of the internal machinery, and in excluding atmospheric air and the vibrations of sound.

But, as was observed in speaking of the attack of this disease upon the auditory passage, we not unfrequently meet with cases of the puriform discharge combined with fungi called polypi, which consist almost entirely of a congeries of blood-vessels, connected by cellular tissue, included in the common integuments. If broken or cut, they yield a sudden and occasionally a large quantity of blood, which Duverney seems to regard as very formidable, but which discharge, when it does occur, soon ceases spontaneously, or may be readily suppressed by the use of astringents or escharotics. These polypous excrescences generally originate from the

floor of the cavity of the drum, and their growth is sometimes so considerable, as not only to fill the whole extent of the auditory canal, but even to project beyond it into the concha or outer cavity of the auricle, and immediate entrance into the ear. The hearing is necessarily rendered very imperfect, and is sometimes wholly suppressed by such a mechanical obstruction to the due admission of sonorous vibrations.

Considerable practical experience, and a thorough knowledge of the structure of the ear, are indispensably requisite to enable any one properly and safely to effect the removal of these polypi. Their external surface, particularly the portion lying in contact with the sides (parietes) of the auditory canal, is generally more or less ulcerated—a circumstance probably induced by the acrid and vitiated secretion from the diseased ceruminous glands irritating the cutaneous surface of these ex-

crecences, which possess a very low degree of vitality. Hence polypi are frequently, though not always, accompanied with a discharge often of a very offensive and acrimonious quality.

When the fungus is the consequence of ulceration and denudation of the bone, the healing process cannot commence until the separation of the carious portion occurs spontaneously, or is effected by such applications as are best calculated to promote exfoliation without irreparably injuring the delicate parts of the auditory apparatus with which they must come in contact.

The accomplishment of this object, either by nature or art, is usually tedious; and in some inveterate cases, the detachment of the diseased portion of bone establishes a direct communication with the basis of the brain, and by inducing inflammation and its consequences, proves speedily fatal. Three instances of this descrip-

tion have fallen under my notice, in which no relief could be afforded.

In the generality of cases, the extirpation of the polypi or fungi affords the most gratifying improvement in the sense of hearing. But sometimes the cessation of the discharge actually *impairs* the function of the organ, the chain of bones being destroyed or rendered useless, and the pus having supplied in some degree their place as a medium for conducting the vibrations of sound. This event may be anticipated if the patient can distinctly perceive light sounds when injected fluid remains in the ear, but on its escape becomes again deaf.

Even under such discouraging circumstances, however, the cure ought to be attempted ;—because, on the one hand, the patient will be released from an exceedingly disagreeable and annoying discharge ; and, on the other,—a still more valid consideration,—the progress of the disease, which by

neglect might have terminated fatally, will be at the same time effectually arrested.

The view taken of this malady shows the great importance of checking it during the early or inflammatory stage, or at all events, as soon as the suppurative action has commenced, at which periods it may almost always be controlled.

Unfortunately, however, from ignorance of its early features and destructive tendency, this affection is too often regarded as a trivial ailment, as one which will subside spontaneously under the restorative efforts of the constitution, or which, when fully established, *cannot* be repressed without risk of entailing worse consequences.

Hence, it is frequently allowed to attain its last stage of malignancy before the patient or his friends apply for relief; when the tediousness, and sometimes the incurable character of the disease, is urged as a

plea for neglecting or altogether abandoning the use of remedies.

But, from the result of ample observation and experience, I am justified in declaring, that a judicious treatment of cases of puriform discharge from the ear, (before irreparable mischief has been inflicted upon its internal structure,) will, if duly persevered in, almost invariably be found adequate to effect the removal of the symptoms, and generally the restoration of the function of the organ.

The plan of cure must necessarily be complex, varying according to the particular stage and features of the disease; and it requires too nice discrimination, in respect to the knowledge and application of local as well as constitutional means, to be confided to any but regular scientific practitioners.

In the possible absence, however, of

those who alone ought to be entrusted with the surgical management of cases of this description, I will suggest the use of a safe lotion, calculated at least to restrain the discharge, and correct the very offensive fœtor it is apt to emit.

Add a tea-spoonful of chlorate of soda to half a pint of rose-water, and fill the affected ear with it every night and morning, allowing the lotion to remain for about five minutes at each application, after which it must be suffered to escape, and a little cotton or wool be introduced into the outer orifice of the meatus.

SECT. II.—*Obstruction of the Eustachian Tube.*

We shall next proceed to inquire into the effect produced on the function of hearing by an obstruction of the passage called the Eustachian tube, which forms a direct communication between the cavity of the

drum and the upper part of the throat. It has already been explained (pp. 46 and 87) that deafness is the certain consequence of an interruption to the renewal of air in the tympanum, and we endeavoured to point out the principle on which that phenomenon depends.

The obstruction or obliteration of this tube may be suspected as the cause of deafness by ascertaining whether any syphilitic ulcer, sloughing putrid sore-throat, (cynanche maligna,) enlarged tonsils, or descent of a nasal polypus, has preceded the disease. Further information may likewise be gained by causing the patient to inflate the tympanum; if he possess this power, the duct must be free; but the converse does not necessarily follow, since all have not the tact and ability to force air into the cavity of the drum, who may nevertheless have a pervious Eustachian tube. We have not indeed any *infallible*

criteria by which to judge of the existence of this disease, the whole of our knowledge on the subject amounting only to what may be called *presumptive evidence*.

The Eustachian trumpet may be closed either in the bony portion of the tube, by ossification, which comes on gradually, and without any premonitory symptoms; or, what is far more frequent, by an obstruction of the mouth of the duct, which opens at the side of the throat. If, therefore, a patient complain of deafness unattended with other symptoms, such as noises in the head, or any of those sensations which indicate a deranged state of the auditory nerve,—and we find, upon inquiry, that he has previously laboured under, or is actually suffering, either of the local affections above-mentioned; and further, that he cannot, by filling the mouth with air, force it into the tympanum,—it is reasonable to infer that an obstruction of the Eustachian tube

is the true cause and essence of the disease.

But simple inflammation of this tube more frequently produces deafness than is generally supposed ; the nature and symptoms of which, though exceedingly distressing and sometimes even alarming, not uncommonly escape detection. In illustration of this, I mention the following cases.

A highly respectable lady wrote to me some months since respecting her daughter (about nineteen years of age), who laboured under a total deafness in one ear, and a great defect of hearing in the other.

She represented the disease to have come on gradually with a slight cold, sore throat, and hoarseness ; symptoms which were soon associated with occasional shooting pains in the side of the neck, extending to the back part and side of the head. These attacked her by paroxysms, the violence of which increased so much as at times to in-

duce fainting. Her nights were restless, her appetite and digestion much impaired, and she became in consequence exceedingly weak and emaciated. Having at the same time cough and purulent expectoration in a morning, with a white tongue, quick pulse, and general febrile irritation, it was feared that the case would terminate in consumption of the lungs (*phthisis pulmonalis*).

The symptoms were too complex and formidable to warrant my venturing to prescribe without the opportunity of a personal inquiry into all the circumstances of the case, which being declared by her justly eminent medical attendants to be highly discouraging, she determined, although residing at a distance of near two hundred miles, to hazard, by easy stages, a journey to London, in order that she might place herself under my immediate care. With great difficulty and some danger, her

object was accomplished ; and after a full investigation of the symptoms, I satisfied myself that they originated from an inflammation of the Eustachian tube, the guttural extremity of which having become slightly ulcerated, afforded the purulent expectoration.

With this conviction on my mind, I prescribed external irritants, and the local application of fumigations and gargles to the inflamed and ulcerated surface, together with appropriate constitutional treatment; —the disease was thus gradually subdued, and I had the gratification of restoring my patient not only to perfect health, but also to the full enjoyment of her hearing.

To a somewhat similar case, in a lady nearly forty-eight years of age, residing in one of our fashionable squares, I was requested to attend in consultation with two eminent physicians, both of whom candidly acknowledged that the symptoms appeared

so anomalous as to baffle their inquiries as to the cause of the disease. After weighing all the circumstances, I intimated my belief that they were referable to an inflammatory condition of the Eustachian trumpet, in which opinion, after I had offered a full explanation of the phenomena, they both entirely concurred. The acute pain occasioned by the introduction of my finger into the throat, and its pressing upon the cartilaginous extremity of that tube, left no ground, indeed, to doubt the correctness of my diagnosis.—This case, like the former, terminated favourably, by pursuing a similar plan of treatment.

A third instance of the disease occurred in an operative mechanic; and although at the period he applied for my assistance, his sufferings were at times exceedingly acute, (and greatly aggravated by the act of swallowing,) and his deafness complete, the symptoms yielded to the means above sug-

gested, and he entirely regained his hearing and general health in as high a degree as before the attack.

A fourth case I am at present attending, in the person of a young and delicate lady, who is residing in London for the purpose of being under my immediate care. This patient, who has just attained her twentieth year, has for many months been afflicted with occasional violent and lancinating pains in her head, neck, and throat, which she attributes to cold caught from incautiously exposing herself to a current of cold air when she was much heated. This induced a slight cough, with mucous expectoration, accompanied by constitutional excitement and distressing deafness. The appetite and digestion were exceedingly defective, and her strength and spirits suffered great depression. These symptoms were soon succeeded by considerable emaciation, and the circumstances altogether

led her anxious friends to feel great alarm lest a fatal disease of the lungs should have actually commenced.

By assiduous attention to general as well as topical treatment, my patient is now entirely released from every alarming symptom, and again capable of perceiving the lowest whisper.

It is not improbable that, the character of the symptoms above detailed so nearly resembling those of pulmonary consumption, they may be sometimes erroneously identified with that disease; a circumstance which may account for the unexpected recovery of patients supposed to be suffering under the last and hopeless stage of that formidable complaint.

The deafness produced by an affection of the Eustachian tube, may be either permanent and complete, or only partial and temporary.

The former character obtains on oblite-

ration of the tube by ossification, (of which I possess, among my collection of anatomical preparations of the ear, a fine specimen,) and on the occurrence of inflammation, tumefaction, and adhesion of the mucous membrane lining it;—states of the tube absolutely irremediable.

The closure of the passage may be partial and only temporary from simple swelling of the parietes, the effect of irritation from cold, or from a collection of mucus, the consequence of an inflammatory sore throat. In these instances, the patient usually recovers his hearing instantaneously, and by a kind of snap, owing to the sudden rush of air into the tympanum. It will be readily understood that gargles are found signally beneficial in such cases of deafness.

In strumous habits, the glandular apparatus of the human body is especially liable to become deranged; and in constitutions

of this nature, the tonsils, (or almonds of the ears, as they are frequently called,) are apt to become, particularly in early life, enlarged, from catarrhal affections—and by their pressure upon the mouth of the Eustachian tube, to cause its partial or total stoppage, and, in consequence, a great diminution, or temporary extinction, of the sense of hearing.

The tonsils, (which are situated on each side of the throat between the two pillars of the pendulous palate, at the root of the tongue and angle of the lower jaw,) are termed, in technical phraseology, *conglomerate glands*; viz. they consist of many smaller ones, united by cellular membrane, each having a distinct excretory duct, whilst the whole is enclosed in the common mucous lining of the fauces, in a mass resembling very much in appearance a defined piece of sponge.

Like all other parts at the back of the

mouth, the tonsils are subject to swellings of various kinds, sometimes inflammatory, to which the young and those of a sanguineous habit are particularly liable. These glands also occasionally suffer under chronic enlargement, which occurs generally in cold damp weather and in indolent constitutions, and by repetition of which they at length assume a schirrous hardness.

Of all the causes of obstruction of the Eustachian trumpet, the enlargement of the tonsils may be esteemed the most frequent. Until experience taught me the following practical fact, I was often puzzled and surprised to find these glands the sole cause of deafness, which, on a cursory examination, did not appear, by any visible tumefaction, capable of closing the mouth of the Eustachian tube. I recollect being exceedingly astonished by a patient who came from Birmingham to consult me on account of the state of his tonsils, which

were so amazingly swollen, that they projected into, and appeared to occupy completely, the back part of his mouth, rendering his speech scarcely intelligible, and both his breathing and swallowing equally difficult and distressing, notwithstanding which his hearing remained unaffected.

In case the *posterior* part of the gland be enlarged, it presses upon and shuts up the orifice of the Eustachian tube, thereby occasioning deafness; whereas the *anterior* lobes of the tonsils may acquire a great size without in the slightest degree compressing or influencing the guttural extremity of that tube;—facts which will satisfactorily account for apparent phenomena otherwise not only inexplicable, but seemingly contradictory.

The use of the tonsils is, by the lubricating quality of their secretion, to facilitate deglutition and the transmission of the solid food into the gullet (*oesophagus*), to

be conveyed by this tube into the stomach. But when these glands assume an unusual magnitude, as in the second species of disease described above, the secretion which they pour out is sometimes so copious, that, by its admixture with the pulpy aliment in an undue and excessive proportion, the digestion is greatly interrupted, and the health becomes in consequence very much enfeebled and deranged.

In the course of my practice, I have found the truth of this statement so abundantly confirmed—particularly in cases of children—that I feel it a duty to make the important communication; and had I permission, I could refer to many of the younger branches of noble families in illustration of the fact—all of whom regained, with restored hearing, their appetite, vigour, and spirits, in proportion to the reduction of these glands to their natural size and healthy secretion.

It is in cases of this description, connected as they generally are with constitutional delicacy and a depraved condition of the digestive organs, that mild alteratives and warm aperients, with the sulphate of quinine in infusion of roses, produce signally good effects.

In many of these cases, the breathing through the nose is very much impeded, owing to the state of irritation and tendency to inflammation and thickening of the mucous or schneiderian membrane, which generally subsides as the swelling of the tonsils is removed.

The method of treating this modification of disorder of the Eustachian tube will depend entirely upon the nature of the exciting cause, which being generally obvious on looking into the throat, our remedial measures must be directed accordingly.

When the Eustachian tube is *permanently*

obliterated, the only mode left to us to restore the hearing, is to admit, through some other channel, the access of air into the cavity of the tympanum, by which process the machinery of the organ will be again set in motion, and its function renewed.

This object, it is clear, from a consideration of the anatomical structure of the parts, may be effected by a perforation through the mastoid process—an operation which Itard states to have been performed upon J. T. Bergman, physician to the King of Denmark, whose death in 1791 was attributed to this cause ; the operation ought not, therefore, to be resorted to but as a last resource.

Sir Astley Cooper, however, being aware that the sense of hearing is not greatly affected on occasions of an opening through, or even of the entire destruction of the

membrane of the drum ; and knowing that, in the puriform tympanic discharge, the hearing, though impaired, is still not *annihilated* ; adopted, with great success, the more rational expedient of making an artificial aperture through the membrana tympani, which is unquestionably a far more simple and satisfactory operation.

Although I have reason to believe that our distinguished fellow-countryman was led to this method of curing the deafness caused by an obstruction or obliteration of the Eustachian tube, by his own observation and pathological reasoning on the nature of the disease and the indications of cure, he was certainly not the first or original discoverer of this remedy.* The effect of an artificial opening, in this description of disease, was known and taken advantage of in practice, with the same intention, by Bo-

* Sir Astley is, however, entitled to the merit of having brought it into general notice.

netus and Riolanus, who have published cases confirmatory of its efficacy.

Preparatory to commencing this operation, the patient must be placed in a strong light, and in such a position that the passage may be fully illuminated, and the membrane rendered plainly visible. A small triangular-pointed trocar, made with a shoulder for this especial purpose, or the pointed end of a common silver probe—which, in default of the former instrument, I have used with success, must be carefully thrust through the anterior and lower part of the membrana tympani. Great caution is requisite, in order to avoid touching the handle of the malleus, which might, with its articulated chain of bones, be dislocated from their connection, an accident which would irreparably injure the function of the organ.

It is also necessary to take care that the instrument be not allowed to penetrate too

far into the cavity of the tympanum, lest its vascular lining be wounded; in which event blood being effused and coagulating, might become organised, and render nugatory the effect of the operation.

A cracking noise will be instantly perceived on the puncture being made, similar to what is occasioned by the pricking of thin parchment whilst stretched, which is more loud and sharp if the tube be totally obstructed, from the rapid entrance of air through the small aperture. The patient, if his case be adapted to this mode of treatment, is instantaneously restored to hearing.

The object and effect of the process is, the substitution of the artificial small hole in the membrana tympani for the obstructed Eustachian tube, by which the air being again admitted into the cavity of the drum, the mobility of the membrane returns, and the action of the small bones,

and all the connecting machinery, is, to a certain extent, re-established.

The puncture is, however, apt to close, as Valsalva found in his experiments on a dog, and occasionally requires to be repeated two or three times, before the aperture, by being made fistulous, becomes patulous and open.

In one instance,—that of a respectable female who resided in St. Paul's Church Yard, whose hearing I succeeded in restoring by this method,—I had occasion to introduce the trocar a second time, in consequence of a re-union of the puncture, and return of deafness—after which, however, it remained permanently open, and the function of the organ continued complete.

This operation, though apparently simple in the hands of an expert practitioner, requires so accurate a knowledge of the situation and structure of the parts to be

acted on, and of the manner of introducing the instrument with success, and without causing mischief, that it ought never to be undertaken by any but such as are qualified for the task by anatomical knowledge and surgical skill.

CHAPTER VI.

DISEASES OF THE INTERNAL EAR, OR LABYRINTH.

HAVING investigated the pathology of the auricle, the meatus externus, the tympanum, and the Eustachian tube, we at length approach the concluding and most intricate division of this important class of diseases.

As morbid anatomy has hitherto thrown so little light on the third or internal portion of the ear, its maladies are in consequence very imperfectly understood.

The whole of this assemblage of disorders,

comprehended under the general but too vague term *nervous*, may, however, be referred either to a want of sensibility in the nerve itself, from irritation or compression at its origin, or in its course; or to some change of structure in the membranous texture in which it is expanded, or alterations in the qualities of the fluid which is contained in, and surrounds the membranous sacs and tubes, in the vestibule, cochlea, and semicircular canals which compose the labyrinth, and forms the immediate agent in impressing the sentient extremities of the auditory nerve.

But it is universally acknowledged to be extremely difficult, even to the most experienced and well-informed practitioner, to ascertain whether the deafness consequent on these ailments be the result of disease, of malconformation of the parts admitting sound to the nerve, or whether it be in the nerve itself.

A consideration of all the various phenomena leads us to separate the affections of the labyrinth into two great divisions—*constitutional* and *local*—or, those which affect the sensitive part of the organ through the medium of the brain; and those which originate from a deranged condition or altered structure of the parts immediately subservient to the sense of hearing.

SECT. I.—*Constitutional causes of nervous Deafness.*

Under this head may be included all those causes of deafness which are seated in the brain itself, and may be regarded either as organic and irremediable, or merely functional, which latter, by proper treatment, frequently admit of relief.

The former class embraces those which depend upon a change of structure in some part of the brain—such as tumors of vari-

ous kinds ; abscesses ; effusion of lymph or serum ; and extravasation of blood, which, by pressure on, or irritation of, the auditory nerve, impairs its energy, or renders it paralytic.

The deafness which sometimes accompanies or follows apoplexy, epilepsy, and hydrocephalus, may probably be accounted for on the commonly received doctrine of cerebral pressure ; although it is known by every accurate pathologist, that the morbid symptoms manifested by the ear, and other senses, are sometimes wholly wanting, when, on dissection, we find ample evidence of pressure from tumors, fluid, &c. within the cranium. We are, therefore, compelled to conclude, that the phenomena depend on causes not yet fully ascertained ; in proof of which remark, I need only refer to the celebrated works of Morgagni and the older anatomists, as well as to the excellent modern treatises on the diseases of

the brain produced by our own countrymen, and by members of the profession on the continent of Europe.

But, defect of hearing may arise from causes of a less formidable description. From the vicinity of the ear to the brain, and the immediate connection which subsists between them through the medium of nerves and blood-vessels, it is easy to conceive, what is really the fact, that the auditory apparatus, like the other organs of sense, must participate in, and be more or less influenced by, the various diseases of the brain, or morbid alteration of its functions. Hence, in a plethoric or congestive state of the blood-vessels within the cranium, marking frequently the approach of apoplexy, deafness is a very common symptom.

On the same principle may be explained the diminution in the sense of hearing, which is apt to supervene on the sup-

pression of accustomed discharges, as the hæmorrhoids or piles in men, and the menses in women. In these cases, the condition of the brain is manifested by vertigo, drowsiness, headache, suffused countenance, and general torpor, which usually precede the loss of energy in the auditory function.

The deafness is plainly referrible, on such occasions, to the retention and accumulation of blood, and consequent turgescence of the vessels of the brain; which probably, by their mechanical pressure, deprive the auditory nerve of its sensibility.

Deafness is also a common attendant in acute fevers,* and at their *commencement*

* It is a remarkable circumstance that deafness in the *first stage* of fever is considered by physicians as a favourable symptom, and in the advanced stages as indicating a fatal termination. In the former case, no satisfactory solution of the phenomenon has hitherto been offered; whilst, in the latter, it is generally re-

has ever been esteemed, from the time of Hippocrates downward, a favourable occurrence. But, during high febrile action, the sense of hearing is often, on the contrary, preternaturally acute; which shows an inflammatory or greatly excited condition of the brain, inducing a morbidly increased susceptibility of the sensorial organ to external impressions. In such cases, the sensibility of the ear is not only painfully augmented, but the patient is, at the same time, incessantly troubled with pulsatory, singing, or tinkling sensations, and other false perceptions of sound.

And, as extremes are said to meet, analogous feelings are commonly experienced by persons of delicate constitution, whose strength and energy have been suddenly reduced by excessive sanguineous discharges; hence, the tinnitus aurium and

garded as one of the certain signs of effusion of lymph or serum within the cranium.

morbid acuteness of hearing consequent upon excessive uterine hæmorrhage.

But *dulness* of hearing may be the effect of a general torpor of the nervous system; as is exemplified in cases of hypochondriasis, with which deafness is no uncommon associate.

It is, however, questionable, whether the dull sensation and torpor of the auditory nerve, as well as many of the symptoms which characterize that disease, are not in reality produced by an oppressed and surcharged condition of the vessels from a sluggish state of cerebral circulation, rather than the offspring, as is generally supposed, of a morbid state of the whole nervous system, communicated, through the medium of the brain, to the sensitive part of the auditory apparatus.

A deranged and loaded condition of the digestive organs is the frequent precursor, or accompaniment of deafness. Hence,

the prevalence of this symptom in children suffering from worms, or whose abdomen is distended by indigestible food, flatulence, and a swollen liver.

The reflex operation of an oppression of the brain is sometimes the cause of a torpid and deranged condition of the digestive organs; at all events, a congestive state of that viscus frequently coexists with that form of disease, occasioned probably by the detention of blood in its vessels, on account of the resistance it encounters on its return from the head.

This view of the subject serves to explain the headache, giddiness, drowsiness, and dulness of hearing, with a sensation of noises in the ear, which are generally observed to prevail in cases of obstruction of the liver, or abdominal viscera.

The stomach is usually represented by physiologists as the centre of universal sympathy; and I am ready to admit that,

as it is an organ which sympathises with every other, its derangements will occasionally affect the most remote parts, especially those which are naturally endowed with acute sensibility. On this ground we may, as indeed is commonly done, offer a satisfactory explanation of the dulness of hearing, as well as of sight, which accompanies morbid states of that powerfully influential organ.

Again ;—deafness may arise from a paralysis of the auditory nerve itself, in like manner as gutta serena, or nervous blindness, is occasionally the consequence of an insensibility of the retina.

In my Treatise on Amaurosis, * I have pointed out the various causes of that dis-

* Practical Treatise on Amaurosis or Gutta Serena (nervous blindness), in which novel views of the nature, and successful modes of treating the disease are developed. 1 vol. 8vo. Published by W. Phillips, George Yard, Lombard Street.

ease, organic and functional; and have shown, by facts and arguments, that the nature of the majority, if not of the whole of those which admit of relief, is explicable on the principle of vascular fulness, even in such cases as have been attributed to *debility*, and other imaginary causes.

The same mode of reasoning which I have adopted in order to explain the phenomena of *nervous blindness*, will tend to elucidate some of the more obscure complaints of the organ of hearing (*paracusis*), and will lead to an equally rational, and as far as is practicable, successful method of treating *nervous deafness*.

By reference to the work in question, a somewhat tedious repetition will be avoided on the present occasion.

SECT. II.—*Local causes of nervous Deafness.*

From the *constitutional*, we shall next

proceed to investigate the *local* affections of the internal ear, which are characterised by the real or imaginary perception of various extraordinary sounds or noises, resembling, according to the apprehension of the patient, the murmuring of a running stream or pebbly brook, or the dashing or roaring of waves in the ocean—the hissing of a boiling kettle—the rustling of dried leaves—or a sense of beating or pulsation in the organ, corresponding with the action of the heart and arteries.—These hallucinations of sound may be associated with a greater or less actual defect of hearing.

Such, then, being the symptoms, what are the local causes of nervous deafness?

On this point our information, it must be confessed, is very limited and imperfect.

Whilst the study of morbid anatomy has been applied with great zeal and success in connecting cause with effect, or diseased

appearances of structure with the phenomena they produce, in most of the other organs of the human body, it is to be regretted that, as we have before observed, little light has been thrown, by anatomical research, on the morbid state of the auditory apparatus; comparatively few attempts having been made, by persons qualified for the arduous undertaking, to trace diseased organization of the ear to its source, and to point out the symptoms which indicate structural defects.

It has indeed been unequivocally ascertained, that *total deafness* is sometimes owing to the labyrinth being filled with a *solid** substance, instead of the *limpid fluid* with which, in its healthy state, it is naturally supplied; and in other instances, of

* The late Mr. Cline found, as was before observed (p. 101), in one case of complete deafness, the whole labyrinth filled with cheese-like matter.

old persons who had entirely lost their hearing, the watery contents of the labyrinth having been absorbed (p. 102), it presented, what it was long thought to be in its *natural* state, a completely empty cavity.

But, in fact, the changes which occasionally take place are too delicate and obscure to be detected either by the eye or knife of the anatomist; in confirmation of which, I will mention the following facts—

Some years since, assisted by an anatomical lecturer, I carefully dissected the brain and ears of a child who had been deaf and dumb, feeling exceedingly desirous to ascertain, if possible, the cause of the complete insensibility of the auditory apparatus. After the most minute examination, we were unable to discover the slightest defect, or alteration in the structure or mechanism of any of the constituent

parts either of the external or internal ear.

"In many instances," says Itard, (the celebrated physician to the Deaf and Dumb Institution at Paris,) in his valuable work on the Ear already quoted, "hearing is paralysed without any antecedent disease, without any known cause, and without any apparent lesion of parts."

In such cases, the malady being congenital, it is probable that it depends upon an original want of power in the nerve to be acted upon by the impressing agent, the transmitted vibrations of sound.

In our inquiries on this subject, we have a great difficulty to encounter, in the little information to be gleaned from the patient, the approach of deafness being frequently slow and insidious; and no strong sensation, painful or otherwise, denoting its commencement, the deaf man is really not

seldom the very last person to discover his own infirmity, and is consequently unable to give a clear and distinct account of the rise and progress of his disease.

It is reasonable, however, to conclude, from analogy, that the membranous texture of the different cavities of the labyrinth is affected, in many of these cases, with inflammation, the presence of which, though exceedingly difficult to detect, may likewise give origin to that distressing acuteness of hearing sometimes experienced.

The syphilitic virus probably acts upon these parts, and produces deafness in the way I have explained, and by the subsequent thickening of the membranous texture and periosteal lining of the different divisions of the labyrinth; a species of disease, respecting the nature of which we have felt warranted in entertaining this opinion, in consequence of its having been

occasionally found to yield to the same remedy (mercury) which is deemed specific in other local affections produced by that morbid poison.

From this fact, then, however obscure and intractable some of the different kinds of nervous deafness may appear, it is manifest that all are not equally so. We should therefore deduce the practical lesson, never to abandon any case, even of this description as utterly hopeless, but endeavour by every rational method to ascertain the nature and cause, if possible, of the morbid derangement, and then have recourse to such remedial measures as analogy, founded on experience in similar instances of disease, may suggest.

By way of encouragement to such laudable efforts, I have the satisfaction to add—what, on many occasions, has been a source of the highest gratification to me—that, by a minute and persevering inquiry

into the symptoms and accompanying circumstances of cases which, on a cursory view, might seem embarrassing in the highest degree, I have been fortunate enough to discover and remove the impediment which kept the auditory function undeveloped, and, in consequence, been the happy means of restoring to the grateful patient the inestimable enjoyment of hearing.

It should not, however, be overlooked, that an investigation of this nature *cannot* be conducted, with the remotest prospect of success, by any but such as have previously made themselves well acquainted with the *general principles and practice* of medicine and surgery, as well as acquired a thorough knowledge of the aural department of the science.

Conclusion.

Having now brought my work to a conclusion, I will briefly recapitulate to the

reader some of the principal points that have been discussed.

Setting out with the intention of giving a concise and general view of the anatomy, physiology, and diseases of the ear; I have dwelt more at large and in detail upon those parts of my subject embracing the greatest portion of interest; a system which, I flatter myself, has not only been pleasing and instructive to the general and philosophical reader, but has, I trust, also presented some considerations worthy of attracting the attention of my professional brethren.

We have seen that the ears occupy a position in the human body the most favourable for the discharge of their important function; and that their curious and complex mechanism is likewise admirably adapted, by an all-wise and bountiful Providence, to the purposes intended. This position and mechanism I have shown to

be varied in the lower (and which are sometimes ignorantly termed *imperfect* animals) according to their several necessities,—as in the hare, the mole, birds, and fishes.

The auricle, by its form and cavities, and the meatus externus, by its varied diameter and windings, terminated by the membrana tympani, are fully calculated to give a proper direction to, and increase the momentum of sound.

The tympanum, with its chain of bones and minute muscles, effectually conveys the vibrations of sound inward; whilst the Eustachian tube, communicating with the external air by the throat, maintains the tension of the membrana tympani; without which, deafness would inevitably ensue.

The stapes, the last of the ossicular link, by its attachment to the membrane of the fenestra ovalis of the labyrinth, of internal ear, conveys the impulse to the extremities of the auditory nerve expanded:

on the pulpy membrane of the several parts of the labyrinth—the vestibule, cochlea, and semicircular canals; while the membranous covering of the fenestra rotunda is well adapted, by its yielding, to allow of the necessary motion in these parts.

From the labyrinth the sound is conveyed, by the auditory nerve, to the brain, and the mind takes cognizance of it in a manner, altogether unknown to us.

In the physiological part, I have related some of the most interesting phenomena respecting the propagation of sound, its reflection, and the media by which it is conveyed; mentioning the different offices performed by the auricle, the meatus, the membrane of the drum, its chain of small bones, the Eustachian tube, and labyrinth.—This portion of the subject, it will have been seen, is confessedly obscure, and merits the further investigation of anatomists, and natural philosophers.

In the third, or principal part of this treatise — that which relates to aural *disease*,—together with discussing the various maladies which do not necessarily impair the function of hearing, I have endeavoured to trace the manifold cases of deafness to their proper source in the different parts affected.

I have thus noticed the erysipelatous and the eruptive disease of the auricle and its vicinity ; the inflammation of the meatus ; the consequences arising from depraved secretion of cerumen ; its inspissation, excess, and defect in quantity.

I have pointed out the injuries arising from the presence of extraneous bodies in the meatus, and the best methods of removing them ; and with respect to the practice of syringing the ears, I have insisted on the necessity of its being effectually, carefully, and judiciously performed.

I have noticed the inflammation and

injuries of the membrana tympani, and the lining of the drum ; their ulceration, and the consequent escape of part or the whole of the chain of bones.

I have also dwelt at length upon the puriform discharge from the tympanum, and given the result of my experience as to the prejudicial effects upon the brain of its sudden suppression, without adequate means of relief to the general system being provided in other directions.

In treating of the diseases of the Eustachian tube, I have remarked upon the frequent occurrence of deafness from enlargement of the tonsils closing its guttural extremity. I have also ventured to call the attention of the profession to a disease of this passage, which, from some striking cases that have fallen under my care, I have just ground to believe simulates *pulmonary consumption* in all its appalling characteristics.

In speaking of diseases of the labyrinth,

I have stated that some of the cases of original or congenital deafness arise probably from alteration or defect in the membranous texture, or expanded nerve contained within it, alike inscrutable to our senses.

This division of the ear we have also seen to be the seat of what is generally termed NERVOUS DEAFNESS; a disease which, although frequently irremediable, I have shown, from analogy with amaurosis, to be sometimes happily cured by means directed to the relief of an inflammatory or loaded state of the blood-vessels of the organ.

On reviewing the whole, I am not aware that I have omitted any circumstance essential to the cure, relief, or prevention of deafness.

An objection may possibly, however, be made by my professional brethren, that I have forborne to offer, as may have been

wished and expected, a *minute* anatomical description of the ear, as well as *full* and *practical* details and information—the result of more than twenty years' abundant experience.—Such a procedure, however, would have been incompatible with the object of this work.

I shall reserve to a future opportunity the publication of a more elaborate and scientific treatise, (in the composition of which considerable progress is already made,) on the anatomy, physiology, and pathology of the human ear, to be addressed exclusively to professional readers.

It is hoped that, without being tediously prolix, or diffusely minute, the present work will nevertheless be found to supply many new and important elucidations, and to place the subjects treated on, in a clearer and more forcible light than has hitherto been attempted.

My pretensions, on this occasion, to public approbation, rest on my having

endeavoured to convey useful information on a topic of universal interest in language intelligible, and, I flatter myself, acceptable to general readers; no learned disquisitions or technicalities excluding those who thirst after valuable knowledge (and such the contents of this work may some time or other prove to most who examine it,) from deriving instruction, and, I trust, even rational amusement, from the perusal of this small volume. It will enable those who have never before contemplated the exquisite structure of the ear, to satisfy their minds that, contrary to prevailing notions, it is no less delicately formed, and much more liable to derangement of its function, than the human eye. It will serve as a guide to the deaf, and as a monitor to those who have an incipient defect in their sense of hearing, to whom it will teach the signs of approaching disease, the expediency of seeking early relief from those only who are competent to afford it, and the danger

of trusting the management of an organ of paramount importance, to the hands of ignorance and empiricism.

From ample and enlarged experience, I feel warranted in declaring, that the functional derangements of any other organ are not more under our control, or more generally curable, than those of the ear, when appropriately treated at their *commencement*, and before irremediable disorganization, or total annihilation of parts essential to its economy, has occurred.

But it too often happens that, from ignorance, prejudice, or inattention, disease is allowed to produce serious structural mischief before recourse is had to medical advice; to which cause may be ascribed the occasional failures that serve to discourage patients, and lead them erroneously to infer, that the ailments of the auditory apparatus are uniformly incurable; a stigma which applies only to their neglected and worst state of inveteracy.

It may be proper, before I conclude, to state my reasons for having studiously avoided encumbering this work with a long, and, in the estimation of persons incompetent to form a correct judgment on the point, an imposing list of cases. Such, had it appeared necessary, or really useful, could have been abundantly supplied, with the trouble only of transcribing them from my note-book. But, since no two instances of what, according to nosological arrangement, are termed the same disease, exhibit in all respects a similar and still less an *identical* concourse of symptoms,—their specification and description would be more apt to mislead than instruct the general reader. A long catalogue of cases which “please the unlearned, but make the learned smile,” would indeed have extended the work, and added to its expense, beyond the limits I prescribed to myself. I have therefore preferred giving the *result* of my

experience in the form of *deductions*, drawn from an immense variety of materials, introducing only a very few examples where they seemed requisite or eligible by way of *illustration*.

In fine, the foregoing pages may be considered as the first production offered to the public, arising from my lengthened observation and extensive practice; and it is unknown to me, if I have advanced a single remark that is not strictly accordant with truth, and which has not been verified by ample, and, as far as the peculiar nature of the several cases would admit, of reiterated experience.

THE END.

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